

Preschool obesity in the Kingdom of Saudi Arabia; Determinants and Feasibility of a Healthy Lifestyle Intervention

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Declaration

I, Mai Adil Ghabashi, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated appropriately throughout the thesis.

Dedication

This thesis is dedicated to my lovely daughter Sahar...

Being pregnant with you has inspired me to start this PhD project.

Having you between my arms has encouraged me to carry on with completing this piece of work, even on the most difficult days.

A further dedication is to all Saudi Arabian children. I hope this dissertation would help in taking a step toward a healthier life in the KSA.

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Abstract

Background: The Kingdom of Saudi Arabia (KSA) ranks among the world's top 10 countries for obesity prevalence. However, little is known about the associated risk factors in young Saudi preschool children. Thus, as a first step, a systematic review was conducted as part of this PhD project. A high prevalence in young children was confirmed; however, the number of studies investigating risk factors was limited. Lifestyle interventions addressing preschool obesity in the KSA are lacking.

Aims: This thesis aimed to improve understanding of the determinants of obesity in Saudi preschool children. It further aimed to develop a culturally tailored lifestyle intervention to address the problem in this age group and evaluate its feasibility in the KSA.

Methods: A mixed methods approach was used. Four studies were conducted to achieve these aims.

Results: Several modifiable risk factors for preschool overweight and obesity in the KSA were identified by the risk factors study. For example, the BMI z-score was 0.4 units higher per unit increase on the fast-food preference scale ($p=0.02$), 0.2 z-scores higher in children who watched TV for more than one hour compared to those that watched for a shorter duration ($p=0.003$), and 0.6 z-scores higher in children who received informal care (e.g. by grandparents) compared to children who received parental care ($p=0.003$). In addition, the qualitative research found that the obesogenic environment and cultural norms in the KSA were identified as risk factors for preschool obesity in the KSA. Feedback from both studies was used to carry out a cultural adaptation of the Trim Tots intervention to make it acceptable to the Saudi population. The feasibility of the adapted intervention was confirmed using a pilot RCT. The intervention was also found to be helpful in increasing the daily intake of fruits and vegetables by 0.5 portions/day ($p=0.01$) and 0.6 portions/day ($p=0.008$) respectively.

Conclusion: A culturally adapted intervention for obesity prevention in Saudi preschool children was feasible. Further evaluation of the feasibility and testing efficacy of the intervention in a wider population is needed.

Impact statement

Issue: Obesity is at the root of several significant health crises. The preschool years are a critical period during which dietary and lifestyle habits start to develop. Once obesity is established, it is difficult to reverse. Therefore, addressing the problem early in life through multi-component interventions is recommended. Although the KSA ranks among the world's top 10 countries for obesity prevalence, data informing the determinants in preschool children are scarce. Interventions to prevent or treat childhood obesity in the KSA are lacking.

Action: As part of this PhD project, I conducted a systematic review to summarise the current evidence regarding young children (0-6 years). The prevalence of overweight/obesity varied between regions and ranged between 19.6 - 35.2% in young Saudi children. However, few previous studies investigated risk factors for obesity, and hence more investigations are needed. Most importantly, no lifestyle interventions to treat or prevent obesity in Saudi preschool children were identified. Therefore, this PhD project addressed this by conducting four studies using a mixed-methods approach. It investigated the determinants of preschool obesity and factors that would encourage participation in a lifestyle intervention in the KSA. This project developed a cultural adaptation of the Trim Tots intervention, a successful programme that complies with UK guidelines for obesity prevention at an early age, to make it suitable and acceptable to the Saudi population. Finally, it tested the feasibility of this culturally tailored intervention that aimed to address preschool obesity in the KSA by conducting a pilot study.

Impact: The originality of this PhD project is four-fold. First; it conducted the only systematic review in the KSA to summarise the evidence with regard to risk factors for obesity in young Saudi children. This was helpful in informing the design of this project. Second; it conducted the first qualitative study that investigated enablers and barriers to participation in a healthy lifestyle intervention for the Saudi population. This was helpful in informing the acceptability of the mode of delivery of a lifestyle intervention that targets the Saudi population. Third; this PhD project made the first attempt to apply a

cultural adaptation of the Trim Tots intervention to make it appropriate to the Saudi population. This adaptation probably encouraged a high level of adherence to the intervention (80% completed the programme). It is known that a high level of adherence to an intervention is likely to increase its efficacy. Fourth; the present PhD project tested the feasibility of the first multi-component intervention (i.e. the Healthy Living study) addressing obesity in Saudi Arabian preschool children and their families. Overall, my work showed that the new intervention was acceptable, and led to beneficial changes in eating habits and obesity-related behaviours. For example, the consumption of fruits and vegetables increased significantly in children of the intervention group compared to their counterparts in the control group. Also, instrumental feeding scores decreased significantly in mothers of children in the intervention group in comparison to the control. If the intervention proved effective in a wider population, it may help in reducing obesity rates in the KSA.

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Abbreviations

BFHI	Baby-Friendly Hospital Initiative
BDA	British Dietetic Association
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHOP	Childhood Obesity Project
CI	Confidence Interval
CVD	Cardiovascular Disease
DD	Desire to Drink
DEXA	Dual Energy X-ray Absorptiometry
DLW	Doubly Labelled Water
EAR	Estimated Average Requirement
EE	Energy Expenditure
EF	Enjoyment of Food
EI	Energy Intake
EMRO	Eastern Mediterranean Region
EOF	Emotional Over Feeding
EOE	Emotional Over Eating
EPL	Energy Providing Liquids
FF	Food Fussiness
FFQ	Food Frequency Questionnaire
FR	Food Responsiveness
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GWAS	Genome-Wide Association Studies
GUSTO	Growing Up in Singapore Towards healthy Outcomes
HENRY	Health Exercise Nutrition for the Really Young
HDL	High Density Lipoprotein
HLS	Healthy Living Study
HPVS	Healthy Plate Variety Score
IGF-I	Insulin-like Growth Factor I
IOTF	International Obesity Taskforce

Kcal	Kilocalories
Kg	Kilograms
KSA	Kingdom of Saudi Arabia
NICE	National Institute of Health and Care Excellence
MAGIC	Movement and Activity Glasgow Intervention in Children
NCMP	National Child Measurement Programme
OB	Obesity
OR	Odds Ratio
OWT	Overweight
PIS	Patient Information Sheet
PPI	Patient and public involvement
RCT	Randomised Controlled Trial
RDA	Recommended Dietary Allowance
RNI	Reference Nutrient Intake
SD	Standard Deviation
SE	Slowness in Eating
SES	Socio-economic status
SR	Satiety Responsiveness
SCT	Social Cognitive Theory
SMART	Specific, Measurable, Achievable, Relevant and Time-limited
SOP	Standard Operational Procedures
SSB	Sugar Sweetened Beverage
TTM	Transtheoretical Model of Behaviour Change
TT	Trim Tots
UAE	United Arab Emirates
UCL	University College London
UNICEF	United Nations Children's Fund
UQU	Umm-Al-Qura University
WHO	World Health Organisation

1. Chapter 1: General overview of overweight and obesity

1.1 Introduction

Overweight and obesity have become a worldwide public health crisis. This chapter will consider many dimensions of the overweight and obesity epidemic, including definitions, prevalence, assessment methods, consequences and risk factors. That will be followed by an overview of the epidemic in the Kingdom of Saudi Arabia (KSA), which is the focal point for this study.

1.2 Definition of obesity

The World Health Organisation (WHO) defined obesity as abnormal or excessive fat accumulation that presents a risk to one's health ⁽¹⁾. At its simplest explanation, obesity occurs as a result of higher energy intake than expenditure ⁽²⁾. The obesity epidemic has become increasingly prevalent, as described below.

1.3 Prevalence of obesity worldwide

Since the 1970s, obesity rates have increased dramatically ⁽³⁾. In 2016, more than 1.9 billion adults were living with overweight, and approximately 650 million with obesity ⁽¹⁾. Overweight and obesity can start to develop early in life (during the preschool years) and tracks throughout childhood into adulthood ⁽⁴⁾. Globally, the number of infants and children under the age of 5 with overweight or obesity increased from 32 million in 1990 to 39 million in 2020 ⁽⁵⁾. Without intervention, this number is projected to reach 70 million by 2025 ⁽⁶⁾. There are several methods for obesity assessment, as indicated in the next section.

1.4 Assessment of overweight and obesity

There are different measures to assess overweight and obesity ⁽⁷⁾. Previously, in 1832, Adolphe Quetelet, an astronomer, mathematician and statistician, developed an index to demonstrate the interdependence of weight and height, as indicated by Eknoyan's review. The Quetelet Index provided a measure of

nutritional status in adults based on their body mass (weight in kg) divided by their height squared (kg/m^2)⁽⁷⁾. Thereafter, Louis Dublin, a statistician and vice president of the Metropolitan Life Insurance Company, led studies to develop tables of weight categories according to people's weight in relation to their height⁽⁸⁾. Later, in 1972, Ancel Keys led epidemiological studies to confirm the validity of the Quetelet Index in terms of a measure of relative obesity, and named it the Body Mass Index (BMI)⁽⁹⁾.

The alarming increase in obesity over the past few decades has led the WHO to declare it as a worldwide epidemic and proposed using BMI as one simple measure of overweight and obesity⁽¹⁰⁾. The WHO defines overweight in adults as a BMI greater than or equal to 25 kg/m^2 , while it defines obesity as a BMI greater than or equal to 30 kg/m^2 ⁽¹⁰⁾. Studies found that BMI correlates with health risks (e.g. heart disease)⁽¹¹⁻¹³⁾. However, it was found that health risks were associated with lower BMI in some Asian population than that in other ethnic populations. Therefore, the WHO recommended to lower the cut-off point for overweight from 25 to 23 kg/m^2 , and to lower the cut-off point for obesity from 30 to 27.5 kg/m^2 ⁽¹⁴⁾.

BMI has a few limitations as a measure of obesity⁽¹⁵⁾. This is because it does not account for differences in bone structure, muscle mass or fat distribution between individuals. In other words, it is an index of overall mass, not specific to fat mass⁽¹⁶⁾. Therefore, BMI is not the most precise measure of fat mass. However, BMI moderately correlates with body fat and it is an acceptable predictor of various diseases⁽¹⁷⁾. BMI, which is an inexpensive and easy tool, is a widely acceptable measure used by many studies⁽¹⁸⁾.

There are additional measures that are likely to provide a better indication of fat distribution that include waist circumference and the waist/hip ratio. Such measures have been found to correlate with metabolic risk factors and cardiovascular complications⁽¹⁹⁾. In addition, skinfold thickness and bioelectrical impedance are other measures of fat mass⁽²⁰⁾. More sophisticated methods provide more accurate measures of obesity. These include Dual Energy X-ray Absorptiometry (DEXA) and magnetic resonance imaging. These are likely to provide a more accurate measure of fat mass, however,

they can be expensive and time-consuming. Another limitation of such methods is that they are not portable ⁽²¹⁾. Therefore, BMI, which correlates moderately with body fat, is used as a tool for defining obesity in many studies since it is an easy and acceptable method.

Concerning children and adolescents, it is difficult to develop one simple index for the measurement of overweight and obesity because their bodies undergo a number of physiological changes as they grow ⁽²²⁾. However, the BMI z-score (standard deviation score) system is used to classify overweight or obesity in children. This method uses growth charts of reference population and adjusted z-score for age and sex. Then, it compares individual's growth measurement against the growth charts of such reference using specific cut-offs that were set to define overweight and obesity ⁽¹⁰⁾.

There are different charts used internationally in order to define paediatric overweight and obesity. Moreover, there are different cut-offs, which may vary according to research purposes. Table 1-1 provides a summary of available growth charts. For example, The International Obesity Task Force (IOTF), which is used to classify overweight and obesity in children, is linked to an adult BMI cut-off, in which the BMI centile curves that pass through a BMI of 25 kg/m² are considered as overweight, while those that pass through a BMI of 30 kg/m² are defined as obese ⁽²³⁾. The Centre for Diseases Control and Prevention (CDC) used a percentile value above 85 to define overweight, while the value above the 95th percentile is used to define obesity ⁽²⁴⁾.

The WHO 2006 Child Growth Standards define overweight and obesity in children under the age of 5. These charts were based on fully breastfed infants who grew up under optimal conditions. Such charts were developed according to growth data from six countries, including Oman ⁽²⁵⁾. It should be noted that Oman is a neighbouring Arab country to the KSA that shares similar characteristics; therefore, these charts will be used to define overweight and obesity in Saudi children under 5-years-old.

According to the WHO 2006 Child Growth Standards, two standard deviations above the WHO Child Growth Standards median is classified as overweight,

while three standard deviations above the WHO Child Growth Standards median is classified as obesity in children younger than the age of 5 years. The WHO 2007 Growth reference was used to define overweight and obesity in children older than 5 years, in which one standard deviation above the WHO Child Growth Standards median is classified as overweight, while two standard deviations above the WHO Child Growth Standards median is classified as obesity⁽²⁶⁾. Childhood obesity is associated with a number of health risks, as explained in the following section.

Table 1-1 Summary of BMI for age charts used to classify childhood overweight and obesity

Reference	Data source	Age	Overweight	Obesity
IOTF ⁽²³⁾	Brazil, Netherlands, Great Britain, Hong Kong, Singapore, US representative survey data	2-18	$\geq 25 \text{ kg/m}^2$	$\geq 30 \text{ kg/m}^2$
US CDC ⁽²⁴⁾	US national surveys	2-20	$\geq 85\text{th percentile}$	$\geq 95\text{th percentile}$
WHO Child Growth Standard, 2006 ⁽²⁵⁾	Multi-Centre Growth Study, Brazil, Ghana, Oman, USA, India, Norway	0-5	+2 SD	+3 SD
WHO Growth Reference, 2007 ⁽²⁶⁾	WHO 2006 and NCHS/WHO (5-18 y)	5-19	+ 1 SD	+2 SD
UK-WHO ⁽²⁷⁾	WHO 2006 and UK 1990 (>4 y)	0-10	$\geq 91\text{st percentile}$	$\geq 98\text{th percentile}$

UK-WHO (United Kingdom, World Health Organization), CDC (Centres for Disease Control and prevention), NHES (National Health Examination Survey), NHANES (National Health and Nutrition Examination Survey), NCHS (National Centre of Health Statistics), IOTF (International Obesity Task Force), SD (Standard deviation), US, United State.

1.5 Magnitude of obesity epidemic

Extensive epidemiological studies have demonstrated that obesity is associated with distinct serious health problems. These include short and long-term adverse health outcomes. For instance, short-term health complications of childhood obesity can include gastroesophageal reflux, obstructive sleep apnoea, fatty liver disease, orthopaedic problems and breathing problems such as asthma ⁽²⁸⁾. Additionally, obesity in children could be associated with psychological issues, including low self esteem, stress, anxiety and depression ⁽²⁹⁾. As for long-term adverse health effects of obesity, they can include increased risk of cardiovascular diseases, atherosclerosis, hypertension, type 2 diabetes and certain types of cancers ^(4;31-35). A summary of obesity-related short and long-term health consequences can be found in Table 1-2. More information with regard to the short and long-term consequences of childhood obesity as well as its imposed burden upon the health care system is provided below.

Table 1-2 Health consequences of paediatric obesity

Short term	Long-term
Asthma	Persistence of overweight and obesity
Gastroesophageal reflux	Hypertension
Obstructive sleep apnoea	Coronary heart disease
Orthopaedic problems	Cancers
Psychological disorders	Type 2 diabetes mellitus
Fatty liver disease	
Dyslipidaemia	
Type 2 diabetes mellitus	

1.5.1 Short-term health consequences of childhood overweight and obesity

The accumulation of fat cells during early childhood is associated with the manifestation of many short-term consequences. Even type 2 diabetes mellitus may develop during childhood. More details with regards to short term-consequences are provided below.

Asthma

Asthma is a health condition that adversely affects the airway of the lungs causing breathlessness, wheezing and coughs ⁽³⁵⁾. The association between asthma and obesity is documented in many epidemiological studies ⁽³⁶⁻³⁸⁾. A meta-analysis of 22 studies (most of which were of a cross-sectional design) showed that obesity increased the risk of developing asthma by 1.5 times in children younger than 10 years ⁽³⁹⁾. An overall quality assessment of included studies was not provided, however, it was mentioned that most studies were not representative of the general population. Therefore, high-quality longitudinal studies that are representative of the general population are sought.

The mechanisms linking obesity with the risk of asthma is not clear, although several hypotheses have been proposed. One possibility is that the pressure of obesity reduces the chest wall compliance, which in turn, reduces the functional residual capacity with concomitant decreased airway diameter ⁽⁴⁰⁾. Another possibility is that obesity-induced cytokines could affect the airway smooth muscles, which could result in airway inflammation and hyper-responsiveness ⁽³⁶⁾. However, as stated, most studies were of a cross-sectional design, which do not allow for detecting causality. Thus, longitudinal birth cohort studies are needed in order to clarify the mechanism underlying the association between obesity and asthma in children. It is important to mention that obesity reduction has advantages in reducing the risk of asthma. According to the analysis of data from 507,496 children (2-17 years), prevention of overweight and obesity is associated with avoiding 10% of asthma developed cases ⁽⁴¹⁾.

Gastroesophageal reflux

Paediatric obesity is a major risk factor for gastroesophageal reflux ⁽⁴²⁾. This could be due to excess central fat, which imposes a pressure on the stomach. As a result, stomach acid flows back into the esophagus ⁽⁴³⁾. It has been reported that the higher the BMI, the higher the risk of symptoms development. However, studies that focus on preschool children, in particular, are scarce and inconclusive, as indicated in a recent literature review ⁽⁴⁴⁾. Nonetheless, some studies that include a wide range of ages found such an association, as indicated by the examples below.

A study that included 627 children aged 2-17 years, found that 20% of obesity cases were associated with gastroesophageal reflux ⁽⁴⁵⁾. Another study conducted in 237 school children (7-16 year olds) reported that 11.7% of children with obesity and 20% of children with severe obesity suffered from gastroesophageal reflux symptoms ⁽⁴⁶⁾. However, most of the evidence was based on studies that recruited children from gastroenterology clinics without control groups ⁽⁴⁷⁾. Thus, this association remains unclear, especially for young children ⁽⁴⁸⁾. In light of this, more research is warranted to provide a better understanding of the association.

Obstructive sleep apnoea (OSA)

Obstructive sleep apnoea (OSA) is a respiratory disorder. It refers to a collapse in the upper airway while sleeping ⁽⁴⁹⁾. Obesity was identified as a contributor to OSA in children according to many studies ⁽⁵⁰⁻⁵³⁾. According to one literature review, the prevalence of OSA was 60% in children (≤ 18 year olds) with obesity ⁽⁵⁴⁾. Another study that included 495 children (≤ 18 year olds) found that obesity was associated with an increased risk of OSA by nearly three-fold ⁽⁵⁵⁾. However, these studies included a wide age range and did not focus on preschool children.

Associations of obesity with OSA are more evident in older children, even though it has also been reported in young children. For instance, a study that included 1583 children (2-15 year olds) found that the average age of children

with OSA was 5.2 ⁽⁵⁶⁾. It was also reported that 32.1% of children with obesity were diagnosed with OSA. Another example included a small study of 60 preschool children, which found that 36% of children with obesity had been diagnosed with OSA ⁽⁵⁷⁾.

The mechanisms linking obesity with OSA are not clearly understood. However, it is suggested that obesity could impose a mechanical effect on the pharyngeal soft tissues and lungs, which would potentially increase pharyngeal collapsibility. Another suggestion includes the potentiality of excess adipose tissue to secrete adipokines and hormones that may activate signals of the central nervous system, which may affect airway neuromuscular control; however, further investigation of such mechanisms is needed ⁽⁵⁸⁾.

Orthopaedic problems

It is suggested that children with obesity are susceptible to orthopaedic problems, such as osteoarthritis, skeletal fragility and fractures ⁽⁵⁹⁻⁶⁰⁾. This is possibly because excess weight can impose stress on the musculoskeletal system ⁽⁶²⁾. In addition, obesity can result in low mineral accretion and hence, adversely affect bone density in children ⁽⁶³⁾. According to one small study that included 95 participants (aged 2-15 years), 60% of children with obesity had orthopaedic problems ⁽⁶⁴⁾. Moreover, compared to healthy weight patients, obesity is positively associated with a high risk of fractures and related complications ⁽⁶⁵⁾. For instance, a study that included 466,997 children (4-14 year olds), and aimed to assess the incidence of fractures, found that the cumulative incidence of fractures during childhood was 13% higher in children with obesity ⁽⁶⁶⁾.

Psychological disorders

Investigations of psychosocial aspects of obesity has grown extensively over the years ⁽⁶⁷⁾. Many studies were conducted to identify the association of obesity related psychological illnesses, such as depression, anxiety and low-self-esteem ^(29; 68-69). However, the results were mixed. This could be due to the heterogeneity of the methodological approaches used to assess different

psychological outcomes ⁽⁷⁰⁾. Nevertheless, it is suggested that, although not all children with obesity are prone to suffer from the risk of developing co-morbid psychiatric problems, there are specific groups of children who are more susceptible to be affected. These include adolescent females and children with severe chronic obesity ⁽²⁹⁾.

With regard to depression, a recent systematic review and meta-analysis of 22 observational studies (most of which were of high quality) confirmed the positive correlation between obesity and depression in children < 18 years of age ⁽⁷¹⁾. The results found that the prevalence of depression among children with obesity was 10.4%. Additionally, the study found that in comparison to children with a healthy weight, children with obesity were 1.3 times at higher risk of suffering from depression. However, detecting causality was not possible due to the observational nature of the included studies. Another limitation is that the age range of children included in this meta-analysis was wide (0-18 years). Thus, there is no clear evidence for the association between obesity and depression in preschool children, in particular. Hence, more substantial evidence is required.

Fatty liver disease

It is possible that obesity could increase the risk of developing fatty liver disease in children ⁽⁷²⁻⁷⁴⁾. For example, 31% of preschool children with overweight or obesity developed fatty liver disease in a cohort study that included 219 participants ⁽⁷⁵⁾. Another study, which included 284 participants, reported that higher BMI in preschool children was associated with higher levels of a fatty liver biomarkers, such as alanine aminotransferase, in comparison to children with healthy weight ⁽⁷⁶⁾. Additionally, a longitudinal study of 513 children showed that obesity at the age of 5 was associated with an 8.9 times higher risk of developing fatty liver disease after 10 years of life ⁽⁷⁷⁾. It is generally accepted that multiple pathways and mechanisms are involved in the pathogenesis of fatty liver disease. This is because the pathophysiology of fatty liver development is multifactorial and still under investigation ⁽⁷⁸⁾. It is important to clarify that fatty liver disease may not have an adverse health impact, but it could lead to more serious health problems,

for example, if it progresses into cirrhosis of the liver ⁽⁷⁹⁾. This is because there is a possibility that untreated cirrhosis of the liver could lead to liver failure ⁽⁸⁰⁾ or liver cancer ⁽⁸¹⁾.

Dyslipidaemia

The association of overweight and obesity in older children with higher risk of dyslipidaemia is well documented in the literature ⁽⁸²⁻⁸³⁾. However, studies on preschool children are limited. Nonetheless, one study conducted on 277 preschool children showed that 65% of children with obesity were diagnosed with dyslipidaemia ⁽⁸⁴⁾. This study also showed that the elevated BMI was associated with higher concentrations of low-density lipoprotein cholesterol (LDL).

The sections above describe the potential short-term consequences of childhood overweight/obesity. The sections below will consider the long-term consequences of childhood overweight/obesity.

Type 2 diabetes mellitus

The link between obesity and the risk of developing type 2 diabetes was investigated in the literature ⁽⁸⁵⁾. Type 2 diabetes mellitus could be considered as a short and long-term consequence of obesity. It may manifest early during childhood or later during adulthood. According to a retrospective cohort study that included 369,362 participants aged between 2-15, obesity was associated with a 3.8 times higher risk of developing type 2 diabetes mellitus during childhood compared to those that were not with obesity ⁽⁸⁶⁾. However, it is interesting to note that the incidence of developing diabetes in children varies among countries, ethnic groups and different ages ⁽⁸⁷⁾.

The mechanisms linking obesity with diabetes mellitus are unclear. However, the “inflammation hypothesis” is proposed to provide a potential mechanism ⁽⁸⁸⁾. Obesity has been associated with chronic inflammation and it is suggested that this is due to higher levels of cytokines and pro-inflammatory markers in individuals with obesity compared to those in the healthy weight category ⁽⁸⁹⁾. These markers are likely to be released as a result of the accumulation of

macrophages in adipocytes. Chronic inflammation may lead to pathological changes in insulin-sensitive tissues and β -cells of the pancreas ⁽⁸⁸⁾. β -cells are responsible for the secretion of insulin, the hormone responsible for regulating levels of glucose in the blood ⁽⁹⁰⁾. Consequently, the impairment of β -cells could be associated with less efficient control of blood glucose, which could lead to the manifestation of type 2 mellitus.

1.5.2 Long-term obesity related complications

Childhood obesity could be associated with adulthood obesity. The relation between childhood obesity and its persistence during adulthood is well documented in the literature ⁽⁹¹⁻⁹⁴⁾. This is supported by the findings of a meta-analysis conducted by Simmonds et al. (2016), which included 15 prospective cohorts with a minimum sample size of 1000 participants (7-18 years). It was found that children and adolescents with obesity were 5 times more likely to develop obesity in adulthood, in comparison to their healthy weight peers ⁽⁹⁵⁾. One major limitation of this study, however, was the risk of attrition bias. Another limitation was the lack of the inclusion of children at preschool age.

Despite the fact that the review from Simmonds et al. (2016) did not include data from preschool children, their findings may still be applied to this age group. That is, children with obesity at school age could possibly have been classified with overweight or obesity when they were younger (at preschool age). A supportive example for this includes the findings of the Early Childhood Longitudinal Study, which followed 7738 preschool children (a mean age of 5.6 years) until eighth grade (a mean age of 14.1 years). This study found that preschool children who were overweight were 4 times at risk of developing obesity by the eighth grade compared to their peers who had a healthy weight ⁽⁹⁶⁾.

It is important to mention that not all childhood obesity could lead to adulthood obesity, since self-recovery is still possible at different ages. Furthermore, the interaction of several factors, including genetic susceptibility and environmental influences, could play a role in terms of stimulating or inhibiting the development of later obesity ⁽⁹⁷⁾. Moreover, the association between

childhood obesity and adulthood obesity is not linear. For instance, a study by Whitaker et al. (1997) found that in comparison to children with healthy weight during childhood, the odds of having persistent obesity during adulthood were higher by 4.7, 22.3 and 17.5 times for children aged 3-5, 11-14 and 15-17 years respectively ⁽⁹⁸⁾.

Childhood obesity induced health related consequences in adulthood

Not only can childhood obesity track into adulthood, but it could also be associated with later health risks, especially in the case of persistent obesity for an extended duration. These adverse health consequences include higher risk of the development of type 2 diabetes mellitus, hypertension, heart disease and cancers during adulthood ^(85; 99-104). This is supported by the findings of a systematic review and meta-analysis which was conducted by Llewellyn et al. (2016). It included 36 longitudinal studies, with a minimum sample size of 1000 participants, which investigated the impact of obesity in children under 18 years of age on health consequences during adulthood. The study found that 31% of future adult diabetes, 20% of future cancers, 21% of future hypertension and coronary heart disease may be partly attributed to obesity during childhood ⁽¹⁰⁵⁾. However, there were a few limitations of this study as indicated below.

First, it should be noted that although longitudinal studies are considered as high quality, there is a risk of attrition bias. Second, many included studies were outdated as they were conducted between 1929 and 1950. Hence, this may limit the generalisability of the findings to present-day children. One last limitation of that study was the wide age range of included children (0-18 year olds). Only 7 studies focused on children aged under 6 and thus, the evidence for preschool children is scarce and firm conclusions cannot be drawn. More studies are therefore needed to help clarify the impact of obesity during preschool years on health consequences during adulthood.

The next section provides more information with regard to potential mechanisms that may explain the association between obesity and the most common related health risks, as reported in the review by Llewellyn et al ⁽¹⁰⁵⁾.

Mechanisms of obesity induced hypertension

The mechanisms linking obesity to hypertension are not fully understood ⁽¹⁰⁶⁾. However, it is suggested that obesity activates the renin–angiotensin–aldosterone system, which is a regulator of blood pressure ⁽¹⁰¹⁾. Higher secretion of angiotensin could lead blood vessels to constrict and become narrower, thus increasing arterial blood pressure ⁽¹⁰⁷⁾. Another potential mechanism is that obesity could adversely affect endothelial function, which is responsible for the regulation of vascular tone and blood flow ⁽¹⁰⁸⁾.

Mechanisms of obesity induced heart disease

Several explanations are proposed to link obesity with heart problems. However, one major issue is that obesity is associated with high levels of low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), cholesterol and triacylglycerol ⁽¹⁰⁹⁾. It is widely accepted that deposition of these fatty substances could lead to the formation of arterial plaques. Such plaques can build up inside the artery walls and may lead to occlusions and reduced blood flow. In turn, severe blockages could completely restrict blood flow to the heart, leading to an ischaemic attack ⁽¹¹⁰⁾.

Mechanisms of obesity induced cancers

Mechanisms linking obesity to cancer differ according to the type of cancer ⁽¹¹¹⁾. However, one suggested mechanism in common is that obesity could increase oestrogen levels, which could result in higher rates of cell division ⁽¹¹¹⁾. At the same time, it is suggested that obesity could inhibit apoptosis. Apoptosis is the process of programmed cell death, which is important for the elimination of unwanted cells. These include, for example, unhealthy cells that are not functioning well. Inhibition of apoptosis could lead to losing control over cell division, which could consequently result in the development of tumours ⁽¹¹²⁾.

The sections above provide an overview of obesity and the magnitude of the epidemic, including details on prevalence and short and long-term health consequences. However, it is also important to note that obesity imposes an

economic burden on healthcare systems. As well as the direct costs of managing obesity, associated adverse health consequences pose a financial burden. This is discussed in the section below.

Economic burden of obesity and associated health risks

Treatment of obesity related complications is associated with high medical costs. According to a systematic review of 9 high quality studies, obesity related illnesses are estimated to consume 10% of the total medical healthcare expenditure. It has also been shown that people with obesity spend 32% greater on medical costs in comparison with people with weight in the healthy range ⁽¹¹³⁾. Most importantly, health consequences of obesity increase the risk of morbidity later in life and earlier mortality. For example, the WHO reported that Non-Communicable Diseases (NCDs), including diabetes, heart disease and cancer, are responsible for approximately 38 million deaths annually and are considered to be the world's largest killers ⁽¹¹⁴⁾. Thus, the number of deaths from NCDs could be lowered if risk factors, including obesity, were addressed.

The previous sections have shown that obesity has become a public health crisis. It can start early in life (during the preschool years) and tracks through childhood and into adulthood. It is associated with short- and long-term health consequences, including asthma, fatty liver, type 2 diabetes mellitus, heart disease and even certain types of cancers. These obesity-induced health complications are associated with an economic burden on the healthcare system. Unfortunately, such NCDs are associated with high risk of morbidity and mortality. Therefore, it is important to understand the determinants that are associated with the risk of developing obesity, in order to prepare a suitable prevention plan. The most common risk factors of childhood obesity are discussed in the following sections.

1.6 General overview of the risk factors for overweight and obesity in preschool children

The aetiology of obesity is multifaceted ⁽¹¹⁵⁾. Genetic susceptibility is one determinant, however, obesity is more likely to be caused by the interaction of distinct factors ⁽¹¹⁶⁾. These include birth weight, developmental factors (e.g. infant feeding and acceleration of growth), behavioural factors (e.g. parental feeding style, child eating behaviour, physical and sedentary behaviour), nutritional factors (e.g. food composition, dietary balance and portion size), socioeconomic status and cultural factors ⁽¹¹⁷⁻¹²⁰⁾.

Of these factors, a few are not modifiable (e.g. genes and ethnicity) or difficult to modify (e.g. socioeconomic status, cultural factors). However, most obesity determinants are modifiable (e.g. diet, physical activity, sedentary behaviour and parental feeding style). It is therefore important to target the modifiable risk factors through interventions, in order to reduce the risk of obesity ⁽¹²¹⁾. More details on modifiable and non-modifiable risk factors will be addressed in the section below.

1.6.1 Non-modifiable risk factors

There are factors that cannot be modified, such as genes, ethnicity and gender. Other factors could be considered as difficult-to-modify contributors, such as parental obesity which may be partially associated with childhood obesity through genetic inheritance. More explanation with regard to these factors is provided below.

1.6.1.1 Genetic factors

Genes play a vital role in the physiopathology of obesity ⁽¹²²⁾. Heritability of obesity is substantial, as confirmed by twin studies ⁽¹²³⁾. The FTO (fat mass and obesity associated protein) gene was the first gene to be identified as a predictor of polygenic obesity. FTO was found to be highly expressed in the brain, particularly in the arcuate nucleus of the hypothalamus. This area is responsible for controlling energy homeostasis and eating behaviour ⁽¹²⁴⁾. A recent study found high FTO expression and enrichment in two other brain

regions known as the insula and the substantia nigra ⁽¹²⁵⁾. These regions are involved in addiction and reward. Hence, interactions between FTO polymorphisms, eating behaviour and psychological health may be associated with obesity ⁽¹²⁶⁾. Although the mechanisms linking FTO to the development of obesity are not yet clear, an overexpression of FTO is associated with higher food intake and a consequent increase of fat mass and weight gain in accordance to genome-wide association studies (GWAS) ⁽¹²⁷⁾.

It is widely accepted that obesity is a polygenic disorder that results from genetic and environmental complex interactions ⁽¹²⁸⁾. In order to identify the genes associated with obesity, GWAS have been carried out since 2007. In GWAS studies, DNA was studied in large cohorts and millions of single nucleotide polymorphisms (SNPs) were identified. It was reported that more than 250 loci (specific positions on a chromosome where a particular gene or genetic marker is located) were identified to be associated with BMI ⁽¹²⁹⁾. Therefore, obesity was classified as a polygenic condition that is associated with many genes. However, the identified loci of obesity genes could only explain <3 % of the variance ^(124, 130-131).

Taken together, it is suggested that individual genes could have a limited effect on BMI, and genes alone cannot explain the obesity epidemic. Therefore, it is important to target modifiable risk factors of obesity through lifestyle interventions to reduce the risk of obesity development. For instance, a study by Wang et al. (2018) investigated the interaction between healthy dietary patterns and genetic predisposition to obesity. This study followed 8828 participants over 20 years and looked at their dietary intakes using food frequency questionnaires. The findings indicated that improving adherence to healthy dietary patterns could attenuate the genetic association with weight gain ⁽¹³²⁾. Discussion of modifiable risk factors including diet is provided later in this chapter. In addition to genetic influence, ethnic disparities are regarded as non-modifiable risk factors for obesity as described below.

1.6.1.2 Ethnicity

Previous studies have shown that the prevalence of obesity varies among different ethnicities ⁽¹³³⁻¹³⁵⁾. The impact of ethnic disparities on obesity has been documented in studies from different countries. For instance, a study conducted in the US that included 2452 preschool children, found that obesity was more prevalent among Hispanic (25.8%) and black children (16.2%) compared to white children (14.8%) ⁽¹³⁶⁾. In the UK, the Millennium Cohort study, which included 19,244 children, found that the risk of obesity was highest in 5-year-old Black Caribbean children. That is, the risk of obesity in these children was 1.7 times higher compared to other ethnicities ⁽¹³⁷⁾. In New Zealand, 2-year-old Pacific children were identified as having a 23% lower risk of obesity compared to other ethnic groups, according to a cohort of 300 participants ⁽¹³⁸⁾. This impact of different racial roots on obesity can be attributed to many factors, including different socioeconomic status, cultural habits, level of education, family characteristics and behavioural norms ⁽¹³⁹⁾. These factors will be discussed later in this chapter.

In addition to genetic and ethnic influences, sex differences are also associated with the risk of developing obesity, as discussed in the next section.

1.6.1.3 Sex

The prevalence of obesity might differ according to sex. The influence of sex on obesity risk may be explained by differences in body composition and hormones in different sexes ⁽¹⁴⁰⁾. The sex influence is clearer in adults compared to young children. This is supported by an ecological study, which looked at the association between occurrence of a disease and suspected factors over time at population level ⁽¹⁴¹⁾. This study included internationally comparable obesity prevalence data in adults from 151 countries. In 87% of these countries, the prevalence of obesity was higher in women than in men, with an average of 6% gap ⁽¹⁴¹⁾. However, the association might not be strongly marked during childhood ⁽¹⁴²⁾. Nonetheless, it is worthy to mention that the biological differences between both males and females appeared as early as the foetal postnatal period ⁽¹⁴³⁾.

It was reported that female infants have more fat mass and less fat-free mass compared to male infants ⁽¹⁴⁴⁾. In contrast, a review paper by Reilly (2005) indicated that no significant difference in obesity prevalence appeared between girls and boys during early childhood, but rather, obesity is associated with age in both sexes ⁽¹⁴²⁾. This suggests that factors other than sex differences, such as living in obesogenic environment with less healthy diet and low level of physical activity, may have a substantial influence on the risk of developing childhood overweight/obesity. An additional factor that could be associated with childhood obesity is parental obesity. It is considered to be a modifiable risk factor, though it is difficult to modify. More explanation with regard to modifiable risk factors is provided below.

1.6.2 Modifiable risk factors

Most contributors to early childhood obesity can be modified. These include infant feeding (i.e. breastfeeding vs formula feeding), parental feeding style (e.g. controlling and instrumental feeding practices), complementary feeding, diet during early childhood and physical activity. Other factors that are difficult, but not impossible to change, include birth weight, parental obesity, cultural and socioeconomic factors. These determinants will be discussed in detail below.

1.6.2.1 Parental obesity

Parental obesity is a strong determinant of childhood obesity ⁽¹⁴⁵⁾. Studies have found this association in both school- and preschool-aged children. For example, one study recruited 582 pregnant mothers and followed up their children until the age of 4. It was found that the risk of developing overweight or obesity increased by 4.1-fold if the mother was also with overweight or obesity, and this risk increased by 5-fold if both parents were with overweight or obesity ⁽¹³⁹⁾. Another example of this was a large study that included 23,043 school-aged children. This study found that parental weight status was associated with their children's weight status. That is, boys were at greater risk of becoming overweight by 1.7 times if they had overweight parents, compared to their counterparts with healthy weight parents. As for girls, the risk of

developing overweight doubled if they had overweight parents compared to their counterparts with healthy weight parents ⁽¹⁴⁶⁾.

The association between parental obesity and childhood obesity can not only be attributed to inherited genes, but also to the common sharable obesogenic environment. Families share, for example, the same lifestyle, dietary habits, cultural and socioeconomic status ⁽¹⁴⁷⁾. These are considered to be modifiable risk factors, as explained later in this chapter; however, it is important to consider that maternal obesity could be associated with gestational obesity, which is a strong predictor of delivering a high birth weight infant. High birth weight could be associated with the risk of developing childhood obesity, as described below.

1.6.2.2 Birth weight

Gestational obesity is associated with higher birth weight ⁽¹⁴⁸⁾. A large body of evidence supports an association between infant birth weight and the risk of childhood overweight/obesity ⁽¹⁴⁹⁻¹⁵⁶⁾. For example, the analysis of data from 22 European countries showed that macrosomic infants (birth weight >4 kg) were at a ≈ 1.1 times higher risk of developing obesity by the age of 6 years ⁽¹⁵⁷⁾. The mechanism that links high birth weight with increased risk of obesity might be explained by higher maternal insulin secretion ⁽¹⁵⁸⁾. Insulin is an anabolic hormone that promotes fat predisposition ⁽¹⁵⁹⁾. According to the current literature, high birth weight could be associated with hyperinsulinemia and consequently, rapid foetal weight gain ⁽¹⁶⁰⁾.

Interventions to improve lifestyle behaviours in pregnant women that seek to reduce the risk of high gestational weight gain and macrosomic infants have been conducted ⁽¹⁶¹⁾. However, such interventions were not entirely successful ⁽¹⁶²⁾. For instance, the UK Pregnancies Better Eating and Activity Trial (UPBEAT) is a randomised controlled trial that recruited 1,555 pregnant women from different ethnicities. This behavioural intervention, which focused on diet and physical activity, was not adequate to reduce the incidence of delivering macrosomic infants ⁽¹⁶³⁾. The insufficiency of interventions during pregnancy to reduce the incidence of delivering high birth weight infants was

also reported by systematic reviews ⁽¹⁶⁴⁻¹⁶⁶⁾. Thus, post-natal interventions might be more effective.

Apart from birth weight, other determinants, such as infant feeding, lifestyle and nutritional factors are important influencers of obesity risk, as described in the following sections.

1.6.2.3 Developmental factors

Developmental factors that could influence the development of childhood overweight/obesity include infant feeding practices. For instance, breastfeeding, formula feeding and the timing of complementary feeding introduction could have moderate effects. These are discussed in the following sections.

Breastfeeding

Breastfeeding is considered as a moderately protective factor against obesity ⁽¹⁶⁷⁾. In 1981, Kramer was the first to indicate the potential protective effect of breastfeeding against childhood obesity ⁽¹⁶⁸⁾. Subsequent studies were conducted to investigate this association before the vital role of breastfeeding as a protective factor against childhood obesity was confirmed. Since then, this connection has been well documented in the literature via systematic reviews and meta-analysis ^(167; 169-171). The sections below will provide more information with regard to the available evidence concerning exclusivity, duration and mechanisms of action.

Exclusivity of breastfeeding

The WHO recommends exclusively breastfeeding infants for the first 6 months of life in order to achieve optimal growth, development and health. Exclusive breastfeeding is defined as no other food or drink, except breast milk (including milk expressed or from a wet nurse). However, the infant may receive drops and syrups containing vitamins, minerals and medicines ⁽¹⁷²⁾. Compliance with such recommendations is of considerable importance, as it may reduce the risks of infection, promote immunity and decrease the risk of developing

obesity ⁽¹⁷³⁻¹⁷⁵⁾. This is supported by an analysis of data from national demographic and health surveys conducted in Bolivia, Colombia and Peru ⁽¹⁷⁶⁾. This study examined the association between exclusive breastfeeding on obesity risk during preschool years, and found that a six-month duration of exclusive breastfeeding was associated with reduced obesity risk in children compared to those not breastfed or received limited duration of breastfeeding. The odds of the reduced risk of obesity were 0.3, 0.7 and ≈ 0.5 respectively.

Additionally, exclusive breastfeeding was of an advantage even for children with high birth weight ⁽¹⁷⁷⁾ and higher genetic susceptibility to develop obesity ⁽¹⁷⁸⁾. Also, breastfeeding could be associated with health benefits ⁽¹⁷⁹⁾. For example, breastfeeding found to be associated with a lower risk of acute illnesses at 6 months and episodes of diarrheal disease and constipation at 6, 12 and 24 months (OR=0.9; $p<0.05$) ⁽¹⁸⁰⁾. Additional later health benefits include lower risks of asthma, allergies and type 2 diabetes at age 25 ⁽¹⁸¹⁾. This highlights the importance of breastfeeding, not only in order to prevent obesity, but also to improve health. In addition to exclusivity, the longer duration of breastfeeding is beneficial in terms of reducing childhood obesity, as expounded upon below.

Duration of breastfeeding

Substantial evidence supports a relationship between breastfeeding and the risk of overweight and obesity in later childhood ⁽¹⁸²⁾. Studies have found a dose-response relationship between longer duration of breastfeeding and lower risk of childhood obesity ⁽¹⁸³⁻¹⁸⁵⁾. An example of a supportive study includes the findings of longitudinal prospective research, the First-Baby. The study included 3,006 participants and found that a minimum of 6 months breastfeeding was associated with lower odds of obesity in 3-year-old children compared to those who were never breastfed (OR=0.4; $p<0.05$) ⁽¹⁸⁰⁾. There are several mechanisms that may explain the protective effect of breastfeeding against obesity. More information with regard to these proposed mechanisms is provided below.

The mechanisms behind the protective effect of breastfeeding against the later risk of obesity

Although the protective effect of breastfeeding against obesity has been proposed by several studies, data available on the mechanisms are quite limited. This is because clinical studies in infants may be unethical at times. For instance, it is unethical to randomise infants to feeding type. Most of the studies are observational and therefore, causality cannot be determined. It is also recognised that social factors, including the level of education and social class, are confounding factors in infant feeding ^(175, 186). Such confounders could be associated with better health outcomes. For instance, mothers with higher level of education are highly expected to exclusively breastfeed their infants up to 6 months compared to those with lower educational level ⁽¹⁸⁷⁾. Nonetheless, the protective effect of breastfeeding was reported by many studies, despite adjustment for confounding factors and in the absence of Randomised Controlled Trials (RCTs) ^(157, 184, 188). Several suggestions have been proposed to explain the protective effect of breastfeeding against obesity risk, as indicated below.

Suggested mechanisms include attributing the protective effect of breastfeeding to the fact that breast milk contains the hormone leptin, according to *in vivo and vitro* studies ⁽¹⁸⁹⁻¹⁹²⁾. Leptin is responsible for appetite regulation and the enhancement of satiety ⁽¹⁹³⁾. Another proposed mechanism is that the protective effect of breastfeeding might be attributed to a lower induction of plasma insulin, thus decreasing fat storage in infants' bodies and preventing excessive early adipocyte development ⁽¹¹⁸⁾. However, the composition of milk in mothers with obesity may be different from that in mothers with healthy weight; further investigation in this is required ⁽¹⁹⁴⁾. Most importantly, the protective effect of breastfeeding is likely to be attributed to slower growth patterns in breastfed infants compared to formula-fed infants ⁽¹⁹⁵⁾. In contrast to a slow growth pattern, growth acceleration is a risk factor for obesity ⁽¹⁹⁶⁾. More information with regard to the role of acceleration growth hypothesis is provided below.

Rapid Growth in Infancy

The concept that early nutrition during infancy which results in a long-term influence on later adiposity first emerged in the 1960s, from the pioneering work of McCance ⁽¹⁹⁷⁾. Several hypotheses thereafter were introduced to explain distinct aspects of the topic. Finally, Singhal and Lucas introduced a unifying hypothesis known as the “growth acceleration hypothesis”. It suggests that early administration of high nutrient diet is associated with long term consequences ⁽¹⁹⁵⁾.

Rapid growth during infancy can adversely influence long term health, by affecting blood pressure ⁽¹⁹⁸⁾, cholesterol concentration ⁽¹⁹⁹⁾ and obesity ⁽²⁰⁰⁾. Rapid growth during infancy is considered as a predictor of the risk of developing later obesity during childhood and adulthood ⁽²⁰¹⁻²⁰²⁾. The mechanism is proposed to operate via programming, which can occur during development as a result of plasticity. Programming can be defined as the process through which the variation of quality and quantity of nutrient intake during a child's development that produces a permanent alteration in phenotype ⁽²⁰³⁾. Therefore, nutrition during the first year of life could play a role in programming the risk of obesity ⁽²⁰⁴⁾.

It is suggested that the shorter the duration of breastfeeding, as well as the early introduction of formula, could be associated with rapid growth, which in turn could result in developing obesity ⁽²⁰⁵⁻²⁰⁸⁾. It is also important to note that the accelerated growth pattern is linked to the early protein hypothesis ⁽²⁰⁹⁻²¹⁰⁾. This hypothesis suggests that high protein intake stimulates secretion of high concentrations of circulating insulin-releasing amino acids. This would in turn stimulate the secretion of insulin and insulin-like growth factor I (IGF-1) ⁽²¹¹⁾. High concentrations of insulin and IGF-1 increases lipogenesis and the development of fat cells, as well as rapid weight gain ⁽²¹²⁾. An example may be demonstrated by higher protein consumption of infants, when breastfeeding is replaced by formula feeding. More explanation with regard to the influence of formula feeding is provided below.

Formula feeding

As opposed to breastfed infants, formula-fed infants grow more rapidly and are more vulnerable to obesity ⁽¹⁸⁸⁾. Although exclusive breastfeeding is the most efficient approach to preventing childhood obesity, mixed feeding (breast and formula milk) is better than exclusive formula feeding ⁽²¹³⁾. This is supported by the findings of a multinational study that included 4,740 school children from 12 countries. The study found that the probability of high fat accumulation in exclusively breastfed children was lowered by 40% (OR=0.6). Meanwhile, it was reduced by 28% among children that were mixed fed (OR=0.7) compared those who were exclusively formula-fed ⁽²¹⁴⁾.

The mechanism that underlies the effect of formula feeding on accelerated growth is not clear. However, formula feeding could stimulate a higher postnatal growth velocity and rapid weight gain, possibly due to high protein content (as explained in the previous section). However, it is not only the content of the formula that is considered to be important, but also the quantity. For instance, over-feeding with formula may increase the rate of infant weight gain. Hence, responsivity to infant satiety cues during bottle feeding (responsive feeding) is important in order to ensure infants are provided with the appropriate quantities. This is described in the section below.

Responsive feeding

Responsivity in parenting involves providing a high level of attention to children's needs including the nutritional aspect ⁽²¹⁵⁾. Responsive feeding, in particular, refers to providing attention to infants' cues ⁽²¹⁶⁾. This includes cues of either hunger or satiety. For instance, providing attention to satiety cues of bottle-fed infants helps in providing the appropriate quantities of milk. Not responding to infants' cues for any reason, including distraction, could have an adverse effect, such as providing infants with larger quantities of milk ⁽²¹⁷⁾. Hence, this could increase the risk of developing overweight/obesity ⁽²¹⁸⁻²¹⁹⁾. It is suggested that distraction during feeding might adversely affect infants' inner ability to self-regulation; this in turn could result in over-consumption, which could lead to rapid weight gain ⁽²²⁰⁻²²¹⁾.

It is believed that infants are born with a nascent capacity for self-regulation that becomes actualized through cause-effect learning process ⁽²²²⁾. This occurs when their behaviour is consistently met with a prompt, developmentally appropriate response. Thus, the level of responsivity to infant satiety cues is most likely to either result in nurturing or impeding the development of a child's self-regulation. However, there was a dearth of high-quality prospective work on this topic. Hence, rigorously designed longitudinal studies are needed to allow a proper investigation on the role of responsive feeding in association to later weight status ⁽²²¹⁾.

In addition to the risk factors discussed above, the quality of complementary food could be another risk factor of obesity. More explanation is available below.

Complementary feeding

According to the WHO, complementary feeding is defined as the process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed alongside breast milk ⁽²²³⁾. The section below will consider the introduction time of complementary foods, as well as the quality of such foods.

Introduction time of complementary feeding

The current recommendation of the WHO is not to introduce complementary feeding before the end of the 6th month of life ⁽²²⁴⁾. Early introduction of complementary feeding could result in energy intake above a child's needs and increase the risk of developing overweight and obesity ⁽²²⁵⁾. The introduction of solid foods earlier than 4 months of age is associated with an increased risk of obesity at preschool age when compared with an introduction of complementary food from around 6 months ⁽²²⁶⁻²²⁹⁾. For instance, a systematic review and meta-analysis of 13 prospective cohort studies (of moderate to high quality) concluded that the introduction of foods before 4 months was associated with a higher risk of obesity during later childhood (2-12 years). This review reported that complementary food introduction before 4 months was associated with a 1.3-fold higher risk of developing obesity during

childhood, in comparison to complementary food introduction between 4-6 months ⁽²³⁰⁾.

It should be noted that the adverse impact of early introduction of complementary food on the risk of obesity is not limited to the preschool period, but also extends to older ages ⁽²³¹⁻²³²⁾. It has further been suggested that, not only might earlier introduction (4-6 months) of complementary food increase the risk of developing obesity, but exposure to certain solid foods could also result in other health risks. This includes heightened immune response to food antigens, which may occur as the infant gut could be immature at that time ⁽²³³⁻²³⁴⁾. Heightened immune response associated with the early introduction of solid foods could result in accelerated telomere ageing, since both telomere activity and length are connected to premature immunity ⁽²³⁵⁾. Taken together, compliance with the WHO recommendations with regard to timing of complementary food introduction is important.

The potential mechanism underlying the association between early introduction of complementary feeding and the risk of obesity remains unclear. However, hormonal factors could be one explanation for such association. It has been suggested that early introduction of complementary foods could activate the secretion of the gastric ghrelin hormone, which is responsible for appetite stimulation, and in turn, increase food consumption and enhance weight gain ⁽²³⁶⁾. However, more prospective studies are needed in order to confirm this pathway of causality, while a more thorough investigation of the quality of the food provided is an important factor to consider, as indicated below.

Composition of complementary food

The quality and quantity of nutrition in early life may have an effect on the individual's metabolism ⁽²³⁷⁾. It was proposed that protein intake increases through the provision of complementary food ⁽²²⁵⁾. This may be associated with obesity in accordance with the early protein hypothesis ⁽²¹²⁾, as explained earlier.

The complementary feeding period is found to influence food preferences, which could be a determinant of childhood obesity ⁽²³⁸⁻²³⁹⁾. Dietary patterns during the first year of life are associated with weight status during later childhood. For example, higher intakes of fruits, vegetables ⁽²⁴⁰⁾ and sugar sweetened beverages (SSB) ⁽²⁴¹⁾ during infancy were found to be associated with higher intakes at 6 years of age. It has also been suggested that commercial ready-to-eat complementary feeding is associated with higher sugar intake, which could result in a positive energy imbalance ⁽²⁴²⁾. This is in accordance with the “growth acceleration hypothesis” that was explained earlier ⁽¹⁹⁵⁾.

When children get older and start to eat by themselves, child eating behaviour may influence weight status, as explained in the next section.

1.6.2.4 Behavioural factors

This section considers the discussion of behavioural factors that have an influence on the risk of developing overweight/obesity in preschool children. This includes child eating behaviour and parental feeding style, of which there are several scales to define these factors, as discussed below.

Child eating behaviour and appetite characteristics

Eating behaviours are defined as “the attitudes and psychosocial factors related to the selection and decision of which food to eat” ⁽²⁴³⁾. Eating behaviour is closely related to appetite regulation. In the context of food and nutrition, appetite is a term used to describe the desire to eat. Distinct concepts, which are known as traits, are applied to describe appetite. The most widely used traits to describe appetite characteristics in children are categorized either as “food approach” or “food avoidant” ⁽²⁴⁴⁾.

Food approach traits demonstrate a desire to eat (e.g. food responsiveness (FR), enjoyment of food (EF) and emotional overeating (EOE)). High food responsiveness is associated with higher food consumption in response to cues including the smell and sight of food ⁽²⁴⁵⁾. Enjoyment of food describes general interest in food ⁽²⁴⁴⁾, while emotional eating describes the tendency to

overeate in response to negative emotions ⁽²⁴⁶⁾. In contrast, "food avoidant" traits demonstrate a movement away from eating. Food avoidant traits include slowness in eating (SE), satiety responsiveness (SR) and food fussiness (FF) ⁽²⁴⁴⁾. Fussy or picky eating in children reflects a spectrum of feeding difficulties and is characterised by a lower willingness to try new foods or even eat familiar foods ⁽²⁴⁷⁾. Satiety responsiveness demonstrates the ability to respond to internal satiety cues and fullness. Hence, high satiety responsiveness is associated with the regulation of food consumption ⁽²⁴⁸⁾. Appetite traits can be assessed using questionnaires ⁽²⁴⁴⁾.

Studies investigating relationships between appetite and obesity risk have shown that "food approach" traits are associated with overweight and obesity, while "food avoidant" traits are associated with underweight ⁽²⁴⁹⁻²⁵²⁾. A recent meta-analysis conducted by Kininmonth et al. (2021) included 27 cross-sectional studies investigating associations between child weight status and eating behaviours. The analysis found that all food approach traits were positively associated with higher BMI z-scores in 2-15 year-old children. Conversely, food avoidance traits were negatively associated with child BMI z-score ⁽²⁵³⁾. However, the included studies were observational and most were of poor quality. Thus, high quality longitudinal RCTs are required to help inform causality and provide estimation of effect sizes to inform the strength of associations.

Another example confirming the association between children's eating behaviour and weight status includes the findings of an Irish birth cohort study that included 229 children aged 5 years. It was reported that children who scored high on the total food approach scale (>2.5 points out of maximum score of 5 for each scale) had a greater risk of developing overweight and obesity when compared to their counterparts who scored high on a food avoidance scale ($p < 0.05$). Children who scored high on food approach scale were nearly 3 times more likely to develop overweight. These children were also 5 times more likely to develop obesity compared to their peers who scored higher on the food avoidance scale ⁽²⁵⁴⁾.

Associations between appetite traits and child weight status have not only been reported in preschool children, but also in older children. For example, a recent cross-sectional study that was conducted in 169 American school aged children (6-10 years) reported an association between food approach traits and the probability of developing childhood overweight and obesity. Higher scores on food approach traits were associated with a higher risk of obesity. Conversely, the study found a significant association between food avoidant traits and a lower probability of developing childhood overweight/obesity ⁽²⁵⁵⁾.

Eating behaviour and appetite characteristics differ from one child to another. It has been suggested that this is not only due to genetic variability, but also to differences in parental feeding practices ⁽²⁴³⁾, as discussed further below.

Parental feeding style/practices

Parental feeding practices refer to strategies employed by parents to regulate the quantity and quality of food consumed by their children ⁽²⁵⁶⁾. These include encouragement to eat, emotional, controlling and instrumental feeding style. Emotional feeding refers to the management of the child's mood and behaviour by providing food ⁽²⁵⁷⁾. In the controlling feeding style, parents often restrict specific food items or try to restrict the amount of food consumption. As for the instrumental feeding style, this involves rewards for good behaviour (e.g., "If you empty your plate, you can have an ice-cream") ⁽²⁵⁸⁾.

Previous studies have found an association between parental feeding style and child weight status ^(250; 259-260). For instance, a prospective cohort study of 323 children found that instrumental feeding was positively correlated with increased BMI z-scores at the age of 2 ($p < 0.001$) ⁽²⁶¹⁾. It is proposed that using food - which is usually highly palatable - as a reward, increases the value of less healthy food ⁽²⁶²⁾. This may lead to a stronger preference for sugary foods ⁽²⁶³⁾ and subsequently a higher consumption of energy, which can be associated with weight gain. Another suggestion to explain why instrumental feeding is associated with a higher risk of childhood obesity is that it may modify a child's eating behaviour toward the adoption of more food approach behaviours that could promote weight gain ⁽²⁶⁴⁾. For example, higher scores of

instrumental feeding were found to be associated with higher scores of food responsiveness and enjoyment of food in children ($p < 0.05$)⁽²⁶⁵⁾. However, causality between instrumental feeding and the risk of childhood overweight/obesity cannot be determined yet.

There is a debate regarding the association between child eating behaviour and parental feeding style. It is not known whether parental feeding styles drive child eating behaviour or vice versa⁽²⁶⁴⁾. Some studies have found that parental feeding style may affect child eating behaviour⁽²⁶⁵⁻²⁶⁷⁾, whereas other research has found that child eating behaviour may predict parent feeding style⁽²⁶⁸⁻²⁷⁰⁾. Parental feeding practices may also differ between siblings in response to each child eating behaviour or personality characteristics⁽²⁷¹⁾. For instance, parents of children with higher scores of food responsiveness may tend to apply restrictive feeding style, while they may apply greater pressure to eat when their children have a high level of satiety responsiveness⁽²⁷¹⁾.

It is important to note that the literature focuses mainly on the maternal role of childcare, since mothers are considered as “the default parent”. In contrast, limited studies investigated the role of fathers in child-feeding aspects⁽²⁷²⁾. Of the limited number of available research, a review of the literature suggested that there are differences in terms of child feeding practices between mothers and fathers⁽²⁷³⁾. For instance, some studies included in the review stated that fathers have higher levels of control of the amount of food consumed by the child and use greater pressure to eat compared to mothers. In addition, it is reported that fathers less frequently use neutral prompts, reasoning, praise and feeding strategies per meal compared to mothers. However, that review reported that further investigations are needed for drawing a clearer conclusion with regard to the role of fathers in influencing their children’s dietary habits and how interventions may involve them.

Overall, the nature and direction of the association between parental feeding style and child eating behaviour are not well understood because most of the studies conducted in this field were observational and very few were longitudinal. Hence, further investigation is needed to understand the relationship and causal direction between these two variables. It is worth

noting that an authoritative parenting style in general is recommended as the most conducive with good behaviours. Furthermore, it is suggested that authoritative parenting styles may improve child eating behaviour ⁽²⁷⁴⁾. More information regarding the influence of effective parenting on eating behaviour in children is provided below.

Effective parenting

There are three main components of an authoritative parenting framework: 1) warmth, 2) control and 3) structure ⁽²⁷⁵⁾. Authoritative parenting styles encourage children to be independent, but with placing limits and rules. These parents are assertive without being intrusive or restrictive. Conversely, authoritarian parenting style is characterised by high levels of control and less warmth and acceptance to children. Parents who apply this style tend to limit their children's independence and force them to follow strict rules via threats or punishment ⁽²⁷⁶⁾.

The influence of an authoritative and authoritarian parenting styles on child eating habits were investigated. A retrospective study that included 424 participants investigated associations between parental feeding behaviours during childhood on dietary habits of children when they became young adults. It was found that parent-centred feeding styles, in which parents directly controlled their children by encouraging them to eat particular foods via pressuring and threatening methods, were negatively associated with the participants' dietary habits later in college. Children of authoritarian parents (those who were subject to parent-centred feeding styles) had low intake of fruits and vegetables compared to their peers of authoritative parents. In contrast to parent-centred feeding, child-centred feeding behaviour was found to be a better approach, in which it was associated with a higher intake of fruits and vegetables ⁽²⁷⁷⁾.

In a child-centred feeding approach, parents indirectly controlled their children by encouraging them to internalize the goal of making healthier dietary choices. Examples of child-centred feeding practices include: 1) providing the child with appropriate choices, 2) allowing them to select what they prefer, 3)

praising healthy food choices and 4) presenting the food in an interesting form ⁽²⁷⁷⁾. According to a study that included 150 preschool children, children who were provided with a variety of choices had a higher intake of vegetables compared to children who were not provided with a choice ⁽²⁷⁸⁾.

Non-directive food parenting practices could also be associated with higher consumption of fruits and vegetables among pre-school children. Indirect parenting behaviours includes talking about the benefits of healthy food choices during mealtimes. A combination of home environment restructuring (including an increase in the accessibility of healthy food items) with non-directive food parenting practices through teachable moments could make a constellation of authoritative practices that enhance the consumption of such healthier food items ⁽²⁷⁹⁾. This is supported by the findings of the systematic review described below.

A systematic review of 22 prospective studies investigated the effective strategies that were used to increase fruit and vegetables consumption in children aged 2-12 years. The review found that utilizing certain strategies, such as restructuring the home environment via increasing exposure to fruits and vegetables, were effective in increasing vegetable intake by 29% ⁽²⁸⁰⁾. However, most of the included studies were not of a high quality, and therefore, more rigorous research is required to inform the influence of authoritative parenting style on children food choices.

Role modelling is another important factor influencing children's eating behaviour. This is supported by the findings of a systematic review, which included 20 qualitative research studies (most were of a high quality). Study designs included focus groups and individual interviews, and addressed the influence of parental feeding practices on preschool children's eating behaviour. This review confirmed the importance of parental role modelling in shaping children's dietary habits. Such influence could be either positive or negative ⁽²⁸¹⁾. Modelling includes verbal or behavioural active modelling, as well as unintentional role modelling. More explanation regarding modelling can be found below.

Parents may rely on verbal means, such as stating their food preferences directly, or they may use physical means, such as eating certain food in front of their children. For example, a small study that included 20 preschool children aimed to improve parental reward and modelling behaviour⁽²⁸²⁾. As a result, it was found that fruit consumption increased by 50% and vegetable consumption increased by 52%. Parents may also unintentionally model obesogenic dietary intake⁽²⁸³⁾ and in doing so, their dietary preferences may be reflected in their children's food intake⁽²⁸⁴⁾.

Moreover, using facial expression is likely to have a profound effect on children's acceptance of several food items. For instance, showing pictures of an individual with an expression of enjoyment whilst eating a particular disliked food item might increase children's desire to consume this food item⁽²⁸⁵⁾. For instance, a small RCT that included 111 preschool children found that, when children were exposed to a picture of a model eating broccoli with a positive facial expression, it led to a higher intake compared to children exposed to a picture of a model with a neutral facial expression⁽²⁸⁶⁾. Hence, it is suggested that interventions aimed at reducing childhood obesity should consider educating parents about effective parenting and other methods like role modelling.

In addition to dietary behaviours, sedentary behaviour and less physical activity are factors associated with childhood obesity and should be considered as primary aspects in preventative obesity programmes. This will be discussed in the following sections.

1.6.2.5 Environmental factors

Environmental factors could play a role in developing childhood overweight/obesity. These factors include lifestyle characteristics and obesogenic environment. More details of these factors are expounded upon below.

Physical activity

There is an inverse association between physical activity level and the risk of obesity ⁽²⁸⁷⁾. Low level of physical activity may also have health risk independent of those related to obesity. These, for example, include poor blood circulation, heart disease, type 2 diabetes and osteoporosis ⁽²⁸⁸⁻²⁸⁹⁾. As a result of this, it is recommended for children under 5 years is to be physically active for at least 180 minutes during the day ⁽²⁹⁰⁾. However, compliance to those guidelines has become a struggle in modern daily lifestyle ⁽²⁹¹⁻²⁹⁴⁾. This is supported by the findings of a longitudinal study conducted in 39 kindergartens involving 7,056 European preschool children. The study reported that 50% of the sample failed to meet recommendations ⁽²⁹⁵⁾. This may be attributed to several factors, such as the availability of suitable spaces (indoor and outdoor). In addition, the attitude of caregivers could have an influence; for instance, the physical activity level for children is associated with that of the caregiver, as indicated by a recent qualitative study conducted by Parrish et al. (2022) ⁽²⁹⁶⁾.

Numerous studies have reported low levels of physical activity among young children (aged 3-5) with obesity when compared to their healthy weight peers ⁽²⁹⁷⁻³⁰⁰⁾. It is expected that promoting physical activity in children could help to compensate for the decline in physical activity levels in children and may be protective against obesity. For instance, increasing levels of physical activity in school children was found to be effective in reducing their BMI z-score according to a study that included 707 children from preschool age to eighth grade (5-14 years). The study was conducted in 24 schools in Massachusetts. These children participated in a programme implemented to increase their physical activity levels by offering them an opportunity to be active for 1 hour before school. Children were divided into two groups: the first group participated in this physical activity programme for 3 days/week, while the other group participated for 2 days/week. By the end of the programme, the children who participated in the 3 days/week programme had lower odds of having lower BMI by 1.3 times compared to the other group ⁽³⁰¹⁾. This example supports the provision of a physical activity intervention to reduce obesity risk.

However, evidence is lacking for preschool children, in particular, as discussed below.

A programme aimed to encourage physical activity in Czech preschool children was conducted in public kindergartens. It encouraged a daily 30–60 min walk outdoors, 20 minutes of indoor exercise, dance and competitive movement games. The effectiveness of the programme was evaluated over ten years (between 2005 and 2015), through a comparison of data from two cross-sectional cohorts. The first study included 176 preschool children and was conducted in 2005, whereas the other study included 210 preschool children and was conducted in 2015. The number of daily steps in preschool children was higher in 2015 than 2005 (11,739 vs 10,922 steps/day; $p < 0.05$). However, the prevalence of obesity did not differ significantly either in 2015 or in 2005 ($\approx 9\%$ vs 7% ; ; $p > 0.05$)⁽³⁰²⁾. This indicates that improving physical activity alone may not be enough to address the problem of obesity in children. Nevertheless, it is an important factor to be targeted in addition to other factors, such as diet and behaviour change. This is because diet is one of major contributor to the risk of obesity, as will be explained later in this chapter.

Sedentary behaviour and screen time

Sedentary behaviour is another predictor of obesity and it could be associated negatively with the level of physical activity⁽³⁰³⁾. Sedentary behaviour refers to the total sitting time or behaviours performed with no or little energy expenditure⁽³⁰⁴⁾. Research into sedentary behaviour has a predominant focus on TV viewing time. However, with today's technological advancements, including increased use of smart devices (e.g. iPhones and iPads), the nature of this area of research has started to change focus to an overall screen time rather than the limited focus on TV viewing time⁽³⁰⁵⁾. Since 2009, the number of articles referring to screen time as that spent not only watching TV, but also on digital technologies (e.g. computers, tablets, online games and smartphones) has increased by approximately 500%⁽³⁰⁶⁾. The analysis of data from five cross-sectional cohorts reported that the proportion of children who are exposed to screen time for more than 2 hours per day grew from 23.6% in 2008 to 63% in 2017⁽³⁰⁷⁾.

In general, screen time is considered as an indicator of sedentary behaviour in children ⁽³⁰⁸⁾. Using smart devices has become the norm of the present daily life, not only for adults, but also for young children. A study conducted in Colorado that included 192 participants found that 92% of preschool children use a smartphone or tablet, and 90% of parents had downloaded applications (apps) specifically for their children ⁽³⁰⁹⁾. According to another cross-sectional study that included 452 children (18 months - 14 years), the mean daily usage of smart devices by children and preadolescents was approximately 3 hours ⁽³¹⁰⁾. The use of devices is associated with poor quality of diet. For instance, in one study, 59% of children using devices consumed chips/crisps and 48% consumed candies as a snack during usage ⁽³¹¹⁾.

The recommendation of screen time use for preschool children in the UK is limited to one hour per day ⁽³¹²⁾. However many children fail to meet these recommendations ⁽³¹³⁾. For instance, a large study that included 9,794 preschool children indicated that they spent approximately 5 hours in sedentary behaviour and almost 2 hours on screen ⁽³¹⁴⁾. According to a systematic review of 13 cross-sectional studies, it was indicated that sedentary behaviours dominate preschool children's time, with more focus on screen time in particular ⁽³¹⁵⁾. However, most studies were not representative, which limits generalisability of findings. Nonetheless, screen time may be different between different countries and cultures. A review of 40 publications investigating sedentary behaviours in preschool children found a high variation in time spent on such behaviour (34-94%) ⁽²⁹²⁾.

Long duration of sedentary behaviours and screen time could be associated with the risk of developing childhood overweight/obesity. A systematic review of 13 reviews found moderately strong evidence for the impact of higher screen time on the development of obesity in children (<18 years). This review found a dose-response relationship between the duration of screen time and the risk of obesity ⁽³¹⁶⁾. Furthermore, according to a study that included 1,282 preschool children, children who watched television for more than 2 hours/day were at a 1.5 times greater risk of developing obesity compared to their counterparts who watched it for a shorter duration ⁽³¹⁷⁾.

The association between screen time and risk of developing overweight/obesity could be attributed to less healthy eating behaviours that may accompany screen time (e.g. SSB and savoury/sweet snacks) ⁽³¹⁸⁾. Additionally, screen time could be associated with exposure to advertisements of less healthy food items. More information regarding media influence on child weight status is provided in the next section.

Media and marketing influence

Media can play a major role in shaping dietary habits of children. This can be through influencing food choices in preschool children. For example, energy dense snacks, sweetened beverages and sugary cereals are widely advertised on TV and such advertisements aim to attract children's attention ⁽³¹⁹⁾. According to a review of the literature, global investment in advertising has reached approximately \$2 billion through different media streams ⁽³²⁰⁾. This means that children are now exposed to huge amounts of advertisements. For example, a content analysis of four channels in the US identified more than 20,000 advertisements directed at children, mainly from the top 11 fast food restaurants ⁽³²¹⁾. Different tactics are used in advertisements that should influence children's dietary habits. Food images that are filmed in "zoom mode" and slow motion have been reported as one of the most influential ways of encouraging children to try these food products ⁽³²²⁾.

Television adverts could be a strong contributor to greater food consumption in children. An example of the impact of TV advertising on children's food intake is illustrated by the findings of a study that included 548 preschool children who were exposed to McDonald's, Subway and Wendy's advertisements. Within a single week of exposure, 43.2% of these children ate at one of those restaurants ⁽³²³⁾. Another study of 624 American preschool children investigated the association between the exposure to child-targeted fast food advertisements and the subsequent intake of these foods. The study found that the probability of eating at McDonald's was increased by two-fold following exposure ($p < 0.01$), even for children of parents who rarely consumed fast foods ⁽³²⁴⁾.

Higher food intake means higher calorie intake. An example of the influence of food adverts on calorie consumption included the findings of a high quality systematic review of 25 studies. Of the included studies, 16 provided data that were eligible for meta-analysis. The pooled analysis showed that children (2-14 years) who were exposed to food advertisements consumed an extra 60 calories per day compared to children who were exposed to non-food advertisements ⁽³²⁵⁾. Another study conducted in the UK included 101 schoolchildren and aimed to examine the impact of high-sugar food and beverage marketing on children's food intake. It was reported that children who were exposed to advertisements for such products had a significantly higher energy intake during the period of the study (48.6 Kcal/day) than children who were exposed to toy advertisements ⁽³²⁶⁾.

Using well-known characters on food product packaging is another strategy used to influence child dietary habit. This is supported by a systematic review of 11 studies (medium quality), which reported that cartoon media characters are considered as a powerful tool influencing children's food preferences, choices and consequent intake ⁽³²⁷⁾. Children show higher preferences for snacks with a label that exhibits a character they like, compared to a regular package that does not exhibit such a character ⁽³²⁸⁾. It is also suggested that the presence of cartoon characters on food packaging influences taste preferences of preschool children ⁽³²⁹⁾.

Unfortunately, most food adverts are not for healthy foods. This is supported by a scoping review, which highlighted discrepancies between marketing and health-based recommendations. Such discrepancies may place children's health at risk ⁽³³⁰⁾. A recent study analysed the nutritional value of 532 food products in the UK and reported that 51% of products with labels featuring cartoon images were classified as high in fat, salt and/or sugar ⁽³³¹⁾. Also, Al-Ghannami et al. (2019) evaluated the marketing techniques used in 11 major grocery stores in Oman, and reported that one of the most common marketing strategies in these stores was to put a cartoon figure on the packaging of food products. Most of these products were less healthy, such as chocolate, cake, breakfast cereals, cookies, sweet and juices ⁽³³²⁾. Food industry funds such

adverts, and it is possibly that they sponsor less healthy items as they produce a greater profit than healthier ones. Hence, it might be the role of policy maker to protect child health by imposing a legislation that manage foods adverts.

Regardless of the adverse influence of media, it can be seen as a double-edged sword. Although it can bring children's attention to less healthy food items, it can also send positive health messages. For example, Popeye the Sailor (cartoon character) was generated in the 1920s to overcome the adverse effect of the first national nutrition crises on children health in the United States ⁽³³³⁾. The key feature of this cartoon series aims to depict the association between the consumption of spinach and the body strength to children. The goal of creating the Popeye character has been successfully achieved. Lovett wrote a paper about the success of the Popeye character in improving the overall health of children by the 1930s. She identified the ability to create a socially tailored effective tool influencing children's dietary choices with a phrase known as "the Popeye Principle". An accreditation of that achievement was evident by increasing the sale of spinach by a third upon children's demand ⁽³³⁴⁾. Moreover, spinach at that time had been ranked as the third favourite food item for children after turkey and ice cream ⁽³³⁵⁾.

Taken together, it is recommended to benefit from the cartoon character's influence on children's dietary habits. This might be achieved by employing the use of such character's influence to send a healthy message encouraging children to eat more healthy foods (e.g. five servings of fruits and vegetable and less savoury snacks and SSB).

Focusing on improving dietary habits of young children is important because nutritional factors exert a strong influence on child weight status. More explanation of the impact of nutritional factors on child weight status is provided below.

1.6.2.6 Nutritional Factors

As indicated above, lower physical activity, and higher sedentary behaviour and screen time combined with the adverse role of media are considered as determinants of childhood overweight/obesity and should be targeted in obesity preventative interventions. In addition to these determinants, it is important to consider nutritional factors (e.g. the quality and quantity of food consumed) since they are strong influencers of childhood obesity. More information is provided in the coming sections below.

Characteristics of preschool children's diet (quality of diet)

The WHO dietary recommendations advise that children consume a balanced diet that includes foods from all five major groups. Meals should be based on starchy carbohydrates, include protein sources, should not be too high in saturated fats and five portions of fruits and vegetables are recommended daily⁽³³⁶⁾. Unfortunately, these recommendations are not met by most children⁽³³⁷⁾. This situation is a worldwide crisis because over the past 20 years, the dietary patterns of children have dramatically changed.

The association between the development of obesity and diet characteristics of preschool children is not well established⁽³³⁸⁾. However, findings from studies that targeted older children might be relevant. For instance, a study that used data of 2,818 children (6–17 year olds) from the US National Health and Nutrition Examination Survey 2003–2006 waves found that the probability of developing overweight/obesity in children who consumed a less healthy diet, and who were physically less active, was higher by 19-fold compared to their counterparts who consumed a healthy diet and were more physically active (OR=19.03, 95% CI: 11.31 to 26.74)⁽³³⁹⁾.

It is reported that diets of young children in many countries have become characterised by energy dense low micronutrient foods⁽³⁴⁰⁻³⁴¹⁾. Consumption of SSB, snacks and energy dense food has increased in preschool children⁽³⁴²⁾, while the consumption of fruits, vegetables, and fibre is often below recommendations⁽³⁴³⁾. A study that included 482 three-year-old children found that higher consumption of processed foods, with more frequent snacks, was

associated with a 1.5 increased risk of obesity ⁽²⁵²⁾. Not only is the type of food a factor, but portion size is another factor associated with child weight status, as indicated below.

Portion size (quantity of foods in the diet)

Much research has linked larger portion size to a higher risk of obesity ⁽³⁴⁴⁾. The “supersizing” of menu items has increased roughly by 2–5 times over the last 2 decades ⁽³⁴⁵⁻³⁴⁷⁾ contributing to obesity. The invasion of present-day technology into food production facilitates the production of large quantities of fat and sugar at very low prices ⁽³⁴⁸⁾. This has improved the fast food manufacturers’ abilities to introduce larger portion sizes at cheaper prices ⁽³⁴⁹⁾. A case in point is the Burger King’s Triple Whopper, which provides 1230 kcal at only a slightly higher price than its original Whopper, which only contains 670 kcal ⁽³⁴⁷⁾. A meta-analytic review found that solely doubling portion size across all food items is responsible for 35% higher food intake ⁽³⁵⁰⁾.

As mentioned previously, higher calorie intake from food could result in a positive energy imbalance. The excess calories would be stored as fat in the body, resulting in weight gain ⁽³⁵¹⁾. Therefore, the consumption of appropriate portion size is considered an important aspect for achieving energy balance and addressing obesity ⁽³⁵²⁾. A lifestyle intervention that targeted 314 preschool children with obesity had provided their parents with recommendations concerning appropriate portion size for preschool children. Over 6 months, the BMI z-score was reduced by ≈ -0.6 points in children who participated in the intervention compared to those who received standard care ⁽³⁵³⁾. This highlights the importance of providing appropriate portion sizes to children in order to achieve energy balance. In addition to the influence of portion size, meal consumption away from home is another factor to consider. This will be discussed in the section below.

Frequency of eating away from home

Frequent eating away from home has become increasingly common. Extensive research had linked eating out and the frequent visits to a fast food restaurant with increasing the risk of obesity ⁽³⁵⁴⁾. A systematic review that

included 71 cross-sectional studies and 16 cohorts (of acceptable quality) from 14 countries found a positive association between excessive access to fast food restaurants and a higher consumption of fast food meals ⁽³⁵⁵⁾. However, the association with weight outcomes was unclear. For instance, of 39 studies that focused on overweight/obesity measures, only 17 found a positive association between excessive access to fast food restaurant and weight gain in children <18 years. Another large cross-sectional study that included 4,349 preschool children reported that those who frequently ate at fast food restaurants were at a 21% higher risk of developing overweight or obesity compared to their peers who did not frequently eat at such restaurants ⁽³⁵⁶⁾.

In contrast to eating out or the consumption of pre-prepared meals, cooking at home is a better alternative, which is associated with higher dietary quality ⁽³⁵⁷⁾. For instance, it was reported that home cooked meals contain more fruits and vegetables compared to pre-prepared meals, based on a study that included 150 families with children aged 5-7 years ⁽³⁵⁸⁾. Another study that included 217 children (3-8 years) found that the activation of a programme promoting cooking was associated with more vegetable consumption ⁽³⁵⁹⁾. Regarding associations between home-prepared foods and weight outcomes, studies in preschool children are scarce. However, examples that included school aged children might be relevant. For instance, a study that included 5,311 children (9-10 years) found that those who are exposed to a higher frequency of home prepared meals were at a lower risk of obesity compared to their counterparts who consumed home prepared meals less frequently ⁽³⁶⁰⁾.

In addition to nutritional factors, socioeconomic and cultural factors may have an influence on childhood obesity. It is important to note that less healthy dietary habits might be driven by socioeconomic and cultural factors as discussed below.

1.6.2.7 Socioeconomic influences

Socioeconomic factors, such as income, occupation and level of education are all important determinants of population health ⁽²⁸⁹⁾. The terms socioeconomic status and social class will be used interchangeably throughout this thesis to

describe the socioeconomic influence on childhood obesity. However, the association between socioeconomic factors and obesity is not straightforward⁽³⁶¹⁾ and varies between countries⁽³⁶²⁾. For example, a review of 58 articles reported that obesity is higher in low-income families in developed countries, but higher in high-income families from developing countries⁽³⁶³⁾. It has been suggested that healthy food, such as fruits and vegetables, are relatively expensive and disadvantaged people may have lower access to healthy food than people from higher SES⁽³⁶⁴⁾. This may be because large supermarkets that sell fresh fruits and vegetables at low prices are located at long distances from families' homes, and paying for transportation might be costly for people of low socioeconomic status. Thus, such disadvantaged groups may buy cheaper food from the nearest supermarket⁽³⁶⁵⁾. These foods might be of a low quality and characterised by high fat and excessive simple carbohydrate intake (e.g. canned and processed food). Thus, consumption of such less healthy diet is likely to contribute to obesity.

Another possible explanation is that less healthy foods might be tastier and preferred by children over healthier choices⁽³⁶⁶⁾. This may encourage parents of low socioeconomic status to buy less healthy food because they know that their children would eat it. In contrast, these parents may not want to spend their money on healthier food, which may not be consumed by their children⁽³⁶⁷⁾.

An example of the influence of low socioeconomic status on childhood obesity in developed countries is demonstrated by the findings of a study that involved 1,979 participants from Germany. It was found that the risk of developing obesity in 6-year-old children of low SES was three-fold higher than children of the highest SES⁽³⁶⁸⁾. Furthermore, the level of education is inversely associated with obesity risk, in which educated people are more likely to make healthy decisions⁽³⁶⁹⁾. For instance, in a study conducted by Lamerz and colleagues, children of parents with low level of education were at three times greater risk of developing obesity compared to children of parents with a higher educational level⁽³⁶⁸⁾. Moreover, according to a review that included 191 publications, people who live in a low income neighbourhood without exercise

facilities are more vulnerable to develop obesity ⁽³⁷⁰⁾. This could be explained by a lower energy expenditure due to the lack of exercising facilities.

In contrast to the situation found in developed countries, obesity is more prevalent among people of high socioeconomic status in developing countries ⁽³⁷¹⁾. This could be explained by several factors. For example, in such communities, a larger body size might be preferable ⁽³⁷²⁾. Hence, weight gain is considered as a positive issue ⁽³⁷³⁾. Additionally, wealthier people in developing countries may tend to eat out more frequently than those of low-income ⁽³⁷⁴⁾. They are able to afford and provide surplus food, which could be associated with a positive energy balance ⁽³⁷⁵⁾. Another plausible explanation is that wealthier people in developing countries are less likely to be engaged in manual labour-intensive occupations. Therefore, a larger proportion of obesity risk in these communities could be attributed to their sedentary lifestyle compared with less wealthy communities ⁽³⁷⁶⁾.

In addition to socioeconomic status, cultural factors also differ from one country to another. Hence, cultural factors may influence obesity differently.

1.6.2.8 Cultural factors

Culture is a system of shared beliefs and attitudes of a specific population. It provides a definition of what is acceptable within the community and set rules for behaviours that are normative (what everyone should do) and pragmatic (how to do it) ⁽³⁷⁷⁾. Hence, each culture is unique, with its own distinct characteristics leading to shaping various dietary habits in distinct populations ⁽³⁷⁸⁾. Different cultural aspects are discussed below.

Body image

Satisfaction of body image differs between cultures ⁽³⁷⁹⁾. Many cultures value larger body size as a cultural symbol of beauty and a sign of family prosperity, fertility and success. For instance, African American men are more likely to express a preference for larger body sizes in women compared to non-Hispanic white men ⁽³⁸⁰⁾. The perceived ideal body size for African American women is significantly larger than it is for white women ⁽³⁸¹⁾. Accordingly, these

women could possibly have the similar ideal body image for their children. To them, healthy child appearance is likely that of a large size. Culture can also influence the perception of risk associated with obesity. For instance, many Latino mothers of children with obesity believe their child to be healthy and are unconcerned about any associated health consequences ⁽³⁸²⁾. Such perceptions may influence feeding practice and food choices, as explained below.

Feeding practices and food choices

In many cultures, family well-being may be demonstrated by children's appearance. For example, having excess fat may be perceived as healthy in some cultures ⁽³⁸³⁾. Based on that perspective, good parenting may involve using certain feeding practices to ensure that children are gaining excess weight. For instance, in Turkish communities, many parents tend to provide their children with food frequently as a comforting tool ⁽³⁸⁴⁾. Among other parents from Brazilian and Australian ethnic minorities, the use of indulgent feeding, such as catering to the child's tastes and wishes, is common practice ⁽³⁸³⁾. Not only are feeding practices possibly driven by cultural values, but so are food choices.

Food is part of the culture and represents the place a person comes from. Food involves the memories of populations and represents connection to roots and origins ⁽³⁸³⁾. The consumption of traditional food could either be a determinant of childhood obesity or a protective factor ⁽³⁷⁷⁾. For instance, a healthy Mediterranean diet, which is characterised by high intake of fruits, vegetables, whole grain and legumes ⁽³⁸⁵⁾, is associated with low risk of childhood obesity ⁽³⁸⁶⁾. In contrast, the traditional African-American foods, which commonly referred to as "soul foods", are associated with the risk of obesity and characterised by high saturated fat, sodium and sugar ⁽³⁸⁷⁾. Such foods include dishes like macaroni and cheese, gravy, fried chicken, barbequed ribs, sweets, biscuits and cakes ⁽³⁸⁸⁾. However, suggestions to change such traditional meals could be considered an affront to cultural values ⁽³⁸⁹⁾. Therefore, interventions need to address the cultural aspects carefully and respectfully. Moreover, considering cultural norms is also important, as discussed below.

Cultural norms

The cultural norms of specific communities could also play a role in developing childhood overweight and obesity. This includes cultural norms that may influence preferences for, and opportunities to engage in, physical activity. For the African American population, sedentary behaviour after a work day is normative. This is because they believe that having a rest after a long working day is healthier than exercising ⁽³⁹⁰⁾. In Latin culture, there is a belief that too much physical activity for young children is harmful and represents a threat to their health ⁽³⁹¹⁾. Conversely, in this culture, sedentary behaviours in young children are seen as important by parents who believe that screen time could be helpful for developing intellectual abilities of these children ⁽³⁹²⁾. It is expected that children coming from these cultures will adopt a similar sedentary lifestyle pattern as adults ⁽³⁷⁷⁾.

Examples of other traditional norms include those embedded in Swedish culture, such as the Cosy Friday and the Saturday Sweets that are regular weekend specific practices ⁽³⁹³⁾. On Cosy Friday, families often gather and spend the evening together and eat snacks (i.e. chips during TV time), while Saturday Sweets refers to the day when children are provided with their favourite sweets or candies ⁽³⁹⁴⁾. Similar patterns are seen in Arab countries and culture, where frequent weekly gatherings are part of the community construct. In these gatherings, sweets and desserts are provided in large quantities. Many mothers reported that they find difficulty in managing their children's dietary intake during such gatherings ⁽³⁹⁵⁾. Moreover, the structure of extended families living together may also have an influence, especially when grandparents are involved in child feeding. This is explained below.

Grandparental influence

The role of grandparents as influencers on their grandchildren's dietary preferences is a key factor in particular cultures ⁽³⁹⁶⁾. However, studies addressing this phenomenon are limited and the current literature is predominantly based on western countries, in which the nuclear families are the majority, with much focus on parents as gatekeepers. Conversely, in other

cultures where extended families are the majority, grandparents could be dominant in shaping children's eating behaviour.

In the Chinese community, for example, many grandparents are the key provider of childcare ⁽³⁹⁶⁾. They may contribute to developing obesity among their grandchildren by holding the belief that heavier children are healthier ⁽³⁹⁷⁾. According to a small study that included 95 Chinese participants, 8-10-year-old children cared for by their grandparents were at twice the risk of developing overweight/obesity in comparison to children cared for by their parents ⁽³⁹⁶⁾. Children cared for by grandparents were found to consume more less healthy snacks and sweetened beverages compared to their counterparts cared for by parents. The same study, carried out a qualitative investigation and reported several statements from Chinese parents, who said they were unable to go against their parents' beliefs and attitudes toward children's feeding practices.

This situation is similar to that in South Asian communities living in the UK. The 'fat' child is perceived as healthy. It has been reported that grandmothers, in particular, hold high respect in such community, wherein they can have control over the diet of children ⁽³⁹⁸⁾. Those grandparents are from a generation who lived in a period when food resources were limited, and this may explain why they consider the bigger child as better.

A common feature of both cultures is that grandparents hold a high level of respect, in which their opinion is valued and should be obeyed. In addition, these grandparents have experienced rapid economic transition, wherein 'bigger is better' is an accepted idea. Supportive examples of the role of grandparents in developing overweight/obesity in their grandchildren is provided below.

Recently, some researchers have started to shed light on the grandparental role in their grandchildren's weight status. For instance, in 2018 a systematic review reported that grandparental participation in feeding their 2-12 year-old grandchildren (by preparing meals) was associated with the risk of developing childhood obesity. The review included 16 studies of moderate to high quality, and the odds of developing childhood obesity ranged between ≈ 1.5 and 1.7

across included countries (Japan, China, USA and Greece) ⁽³⁹⁹⁾. According to another study that analyzed data from 267 Hispanic families, the odds of developing overweight/obesity in 2 year-old children living with their grandparent (vs none) was 4.3 times higher ⁽⁴⁰⁰⁾. Additional meta-analysis of 14 studies found that grandparental care was associated with a 30% increase in risk of developing overweight in children <17 years ⁽⁴⁰¹⁾. However, the included studies were of an observational nature, which hindered establishing a causal association.

In brief, the above section addressed the risk factors associated with childhood overweight/obesity. However, the interaction of such determinants and their impact on the risk of developing childhood overweight/obesity may differ from culture to another. In this regard, little is known about the situation in the KSA, the subject of discussion in this study. In fact, the rapid increase in obesity rates in the KSA followed the discovery of oil in the 1960s. A significant economic shift accompanied the discovery of oil, and thus, the region experienced a nutritional transition. Food resources have become more abundant and lifestyles have been altered, in which sedentary behaviours have become the norm ⁽⁴⁰²⁾. This nutrition transition in general, may explain the rapid increase in obesity rates in the region. More information regarding the magnitude of the obesity epidemic in the KSA will be provided below.

1.7 Overview on overweight and obesity in the KSA

The Kingdom of Saudi Arabia is the largest Arab state in Western Asia, representing around 80% of the Arab Peninsula ⁽⁴⁰³⁾, with 13 different provinces (Figure 1-1) ⁽⁴⁰⁴⁾. The KSA ranks among the world's top 10 countries for obesity prevalence ⁽⁴⁰⁵⁾, with 69.7% of adults estimated to be with overweight and 35% with obesity ⁽⁴⁰⁶⁾. According to a study that included 4,708 participants, obesity in the KSA was associated with greater odds of developing several NCDs: (OR for type 2 diabetes; 1.5, OR for hypertension; 1.6 and OR for thyroid disorder; 1.8) ⁽⁴⁰⁷⁾. In 2019, the medical cost of illness due to obesity in the KSA was estimated to reach \$19 billion per year ⁽⁴⁰⁸⁾.

Obesity in the KSA has increased considerably over the last three decades, not only in adults, but also in children ⁽⁴⁰⁹⁾. The latest national report on obesity in Saudi school children (5-18 years) by El Mouzan et al. (2010), found that 23% were with overweight and 9.3% with obesity ⁽⁴¹⁰⁾. However, this study is outdated as it was conducted 12 years ago; hence, updated records are urgently needed.

With regard to preschool children, there is a paucity of available data. Nonetheless, an older study from 2010, which was conducted by Al-Dossary et al, reported that the prevalence of obesity in Saudi preschool children was 37% ⁽⁴¹¹⁾. Another limitation of this study is that it focused only on children living in the eastern providence, which may not be representative of the wider population in KSA ⁽⁴¹¹⁾. The section below will consider childhood obesity in the KSA.

Figure 1-1 Map of the Kingdom of Saudi Arabia



Adapted from Yezli et al. (2012) ⁽⁴⁰⁴⁾

1.8 Childhood obesity in the KSA

Studies investigating childhood obesity in the KSA are limited. During the last five years, only two reviews have reported the prevalence of obesity in Saudi children (2-20 years) and the associated risk factors ⁽⁴¹²⁻⁴¹³⁾. It is suggested that obesity prevalence in Saudi children is similar to that in western countries, and that it is increasing in all provinces ⁽⁴¹⁴⁾. For instance, in Jeddah, the nearest city to Makkah, the prevalence of obesity among preschool children was at 10.8% in 2007 ⁽⁴¹⁵⁾. This prevalence increased to 15% in 2017 ⁽⁴¹⁶⁾ and reached 19.6% in 2020 ⁽⁴¹⁷⁾.

Concerning the risk factors for obesity in Saudi children, several determinants were identified in the two most recent childhood obesity reviews conducted in 2017 ⁽⁴¹²⁾ and 2020 ⁽⁴¹³⁾. These risk factors included less healthy dietary habits, such as inadequate intake of fruits and vegetables and frequent consumption SSBs as well as fast foods. Less active lifestyles and longer durations of screen time were other identified determinants. However, it is important to note that the age range in the included studies of both reviews were very wide (2-20 years). Thus, there is little data with regard to preschool children in particular.

Insufficient data on the levels of overweight and obesity and the underlying risk factors in preschool Saudi children is a gap in the literature that needs to be addressed. Therefore, I conducted a systematic review in the next chapter to summarise the evidence for the prevalence of overweight/obesity and its risk factors in Saudi preschool children, which is the focus of this thesis. This would enable a further understanding of the scale of the obesity epidemic in the KSA and provide useful information to inform future obesity prevention interventions.

1.9 Chapter Summary

To summarise, overweight and obesity is a major public health crisis worldwide. It is a multifactorial disease that develops as a result of interaction between several determinants, including genes, ethnicity, sex, growth patterns, eating behaviour, diet and physical activity. Overweight and obesity are associated with short- and long-term health consequences. These include fatty liver, type 2 diabetes mellitus, orthopaedic problems, heart disease and even certain types of cancer. Most importantly, such health complications could increase the risk of morbidity and premature mortality. Therefore, obesity prevention is of considerable importance. Although few factors cannot be modified, such as race and genetic susceptibility, most other determinants can be modified through lifestyle interventions.

With regard to the KSA, overweight and obesity has become highly prevalent. However, current data on risk factors in preschool children are very limited. Therefore, a systematic review was conducted in Chapter 2 to fill in this gap in the literature and provide adequate understanding of the scale of the problem and its associated risk factors.

2. Chapter 2: Systematic review of obesity prevalence and risk factors in Saudi young children (0-6 years)

2.1 Introduction

In light of scarcity of data on prevalence and determinants of preschool obesity in the KSA, I conducted a systematic review to summarise the available evidence with regard to the prevalence of obesity in young children, and sought to identify the associated risk factors specific to the KSA. This would contribute to informing interventions that aim to address such an epidemic in the country. Details with regards to aims, methods and findings are provided below.

2.2 Aims

The objective of this systematic review is two-fold:

- 1) Summarise the evidence for the prevalence of overweight and obesity in young Saudi children.
- 2) Identify risk factors associated with overweight and obesity in young Saudi children.

2.3 Methods

Search strategy

A systematic search was conducted to identify relevant publications describing childhood obesity and risk factors in the KSA. Electronic databases were searched, including EMBASE and MEDLINE (Ovid). The database search was initially conducted on 28th October 2017, and updated to 20th April 2022. The search strategy was carried out according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) ⁽⁴¹⁸⁾. Details of the search strategy can be found in Appendix A.

Study selection

Included studies either provided data on the prevalence of overweight and obesity in children or investigated its associated risk factors. The definition of overweight and obesity was not limited to a specific growth reference and all definitions used by the authors were considered eligible. Abstracts were screened, then studies that met the inclusion criteria (described below) were included for full-text review; accordingly, studies that did not meet these criteria were excluded (Figure 2-1).

Inclusion criteria

- Studies that included data from the KSA.
- Published in English or Arabic.
- Study populations included children between the ages of 0-6 years.
- Healthy children (not diagnosed with medical or health conditions).
- Included anthropometric measurements.
- Defined overweight and obesity (Different BMI-for-age cut-off points were considered acceptable for this review).

Exclusion criteria

- Studies only conducted in another Arab country.
- Children that only included older than 6 years old.
- Children diagnosed with a medical health condition.
- Studies in animals.
- Studies not reporting quantitative data.

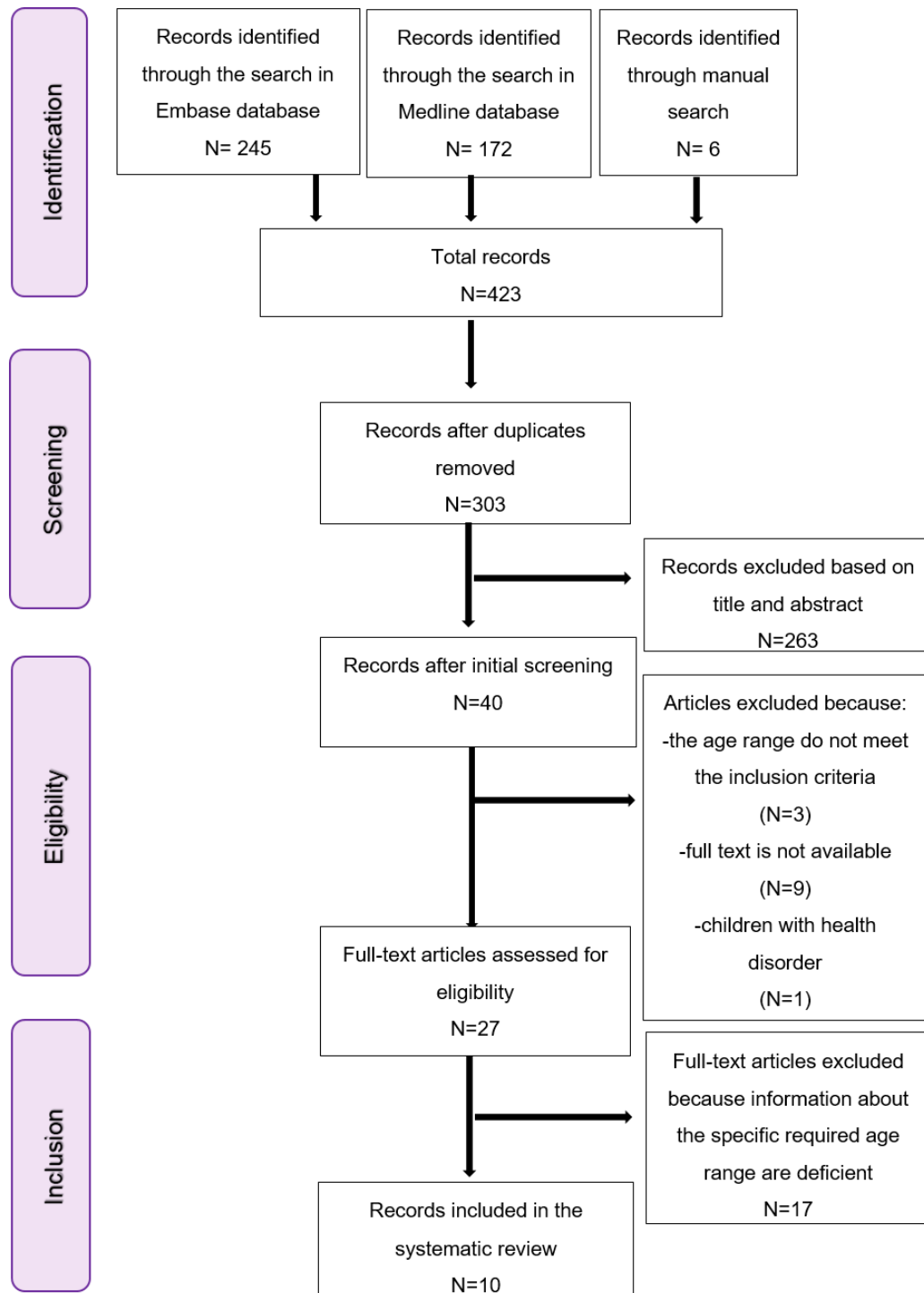
Data extraction

Two reviewers (myself and Sarah Raquqe, a fellow PhD student at UCL) completed the screening process and agreed on selected studies that met the inclusion criteria for this systematic review. Data was extracted from each study, including: (i) characteristics of the study design and participants, and (ii) methods used to define overweight and obesity (e.g. BMI cut-off points and

growth reference used). In studies where young children were included as part of a wider age range, the data for these children was extracted. Standard cut-off points used to define overweight and obesity were reported. Prevalence was reported as a percentage.

Quality assessment

The quality of included studies was assessed using a modified version of the Downs and Black checklist ⁽⁴¹⁹⁾, which was designed to assess bias in both randomised and non-randomised studies. This checklist was modified by Al-Tarrah (2018) ⁽⁴²⁰⁾ and questions relevant to RCTs and intervention studies were excluded. The included questions covered specific aspects that were relevant to cross-sectional studies reporting the prevalence of overweight and obesity in preschool children in the Arabian Gulf region, including the KSA. This list of questions can be found in Appendix B. Specific aspects of the studies were assessed to evaluate their quality, including internal validity (e.g. appropriateness of statistical tests used) and external validity (e.g. representativeness of study population). The maximum score possible was 9. Interpretation of quality was performed according to the quality index rating of a previous systematic review that used a modified version of the checklist ⁽⁴²¹⁾. That is, a score of ≥ 7 was considered as good/high quality, a score between 4-6 was interpreted as moderate quality, and a score less than 3 was considered as poor.

Figure 2-1 PRISMA flow diagram for selection of studies

2.4 Results

According to the search strategy, and as shown in Figure 2-1, 417 studies were identified from the electronic database searches and a further 6 studies were identified using a manual search. After removing duplicates, 303 titles and abstracts were screened. Of these, only 10 cross-sectional studies met the inclusion criteria for this systematic review. Data from 14,413 young children living in the KSA was available. The sample size of included studies ranged from 95 to 2,943. As shown in Table 2-1, the reported characteristics of included studies were authors, year of publication, region, age, sample size, methods used to measure overweight/obesity and quality assessment.

Different growth references were used to assess overweight and obesity in young children across the included studies (specifically, IOTF, CDC, and WHO). In addition, different methods for overweight and obesity assessment (e.g. BMI, BMI centile and z-score) were used across these studies. In five studies, the primary outcome to assess overweight and obesity was BMI percentile ^(411,416,422-424). In these five studies, the cut-off for overweight was at or greater than the 85th centile, while that for obesity was at or greater than the 95th centile. In three studies, BMI z-score was used to assess childhood overweight/obesity ^(410,417,425). In two of these three studies, WHO Growth Standards (2006) was used in which overweight was defined as 2 SD above the mean, while obesity was defined as 3 SD above the mean ^(410,417). One study used the WHO Growth Reference (2007), in which a cut-off greater than 1 SD was used to define overweight and a cut-off greater than 2 SD was used to define obesity ⁽⁴²⁵⁾.

A further study used BMI as the primary outcome. Children with BMI at or greater than 25 were defined as overweight, while those with BMI at or greater than 30 were defined as obese according to the IOTF criteria ⁽⁴²⁶⁾. Another study used body fat as a method to assess obesity. Boys with a body fat percentage that equals or exceeds 25% were defined as obese, while girls with a body fat percentage that equals or exceeds 30% were defined as obese ⁽⁴¹⁵⁾.

Most studies were of a moderate to good quality (ranging between 5 and 7). However, most studies scored poorly in terms of representativeness of the studied population, while they scored well in terms of defining objectives and measured outcomes. There was a heterogeneity of included studies in terms of sample size and obesity assessment measures. Only two surveys were representative of the national prevalence of childhood obesity in the KSA. These studies were national surveys conducted by El-Hazmi and Warsy (2002) ⁽⁴²⁶⁾ and El Mouzan et al. (2010) ⁽⁴¹⁰⁾, as discussed below.

The first survey which was conducted by El-Hazmi and Warsy (2002) had obtained data based on an extensive national project concerning various aspects of diabetes mellitus ⁽⁴²⁶⁾. This survey was carried out in different areas of Saudi Arabia from 1994 to 1998. The second representative study which was conducted by El Mouazean et al. (2010) had used data from the National 2005 Survey, which collected data using stratified listing based on the population census in the KSA ⁽⁴¹⁰⁾. Data on young children were extracted from both studies. Information with regard to the prevalence of overweight and obesity that were reported by the present systematic review can be found below.

2.4.1 Prevalence of overweight and obesity in young children living in the KSA

As mentioned above, only two studies were representative of the national prevalence of overweight and obesity in Saudi Arabian children. Such prevalence was at 14.5% according to El-Hazmi and Warsy's study (2002) ⁽⁴²⁶⁾, and it was at 11.2% according to El Mouzan's study (2010) ⁽⁴¹⁰⁾. Another old study conducted by El Mouzan et al. (2012) investigated the prevalence of childhood overweight and obesity among three different regions in the KSA (central, southwest and north Saudi Arabia) ⁽⁴²²⁾. This study found that the southwestern region had the lowest prevalence of overweight and obesity in young children, which was at 11.1%, while the central and northern regions had similar prevalence (23.4% and 23.5% respectively) ⁽⁴²²⁾. An additional old study, by Al-Dossary et al. (2010), had reported a high prevalence of

overweight and obesity in young children in the eastern province that reached 37.3% ⁽⁴¹¹⁾.

There are no updated national studies on the prevalence of overweight and obesity epidemic in young Saudi children. However, recent studies across different provinces reported that the prevalence of overweight and obesity is high. For instance, in 2017, one study conducted in the western region found that the prevalence of overweight and obesity in young Saudi children was at 25% ⁽⁴¹⁶⁾. An additional study that was also conducted in the western region found that the prevalence was 19.6% ⁽⁴¹⁷⁾. Additional studies in the central region reported a prevalence of 28% ⁽⁴²⁴⁾, 35.2% in the north region ⁽⁴²³⁾ and in the southern region, a prevalence of 34.7% ⁽⁴²⁵⁾.

As indicated above, all the included studies (n=10) provided information with regards to the prevalence of overweight/obesity in the studied samples. However, only four studies focused mainly on investigating the risk factors of overweight and obesity in young Saudi children ^(417; 423-425). Another three studies, which aimed primarily to describe the prevalence, investigated a few determinants of overweight/obesity involving the sex influence, duration of watching TV and physical activity ^(411; 415-416). Thus, seven studies in total provided data with regard to the risk factors of overweight/obesity in young Saudi children, as shown in Table 2-2. A summary of the investigated risk factors was illustrated in Figure 2-2. These risk factors included non-modifiable and modifiable ones. More details with regards to data synthesis can be found below.

2.4.2 Non-modifiable risk factors

The included studies did not investigate the influence of genes or ethnicity on the risk of developing overweight/obesity in young Saudi children. Sex was the only non-modifiable risk factor that was investigated across six studies ^(411; 415-417). However, three of the studies found mixed findings with regard to the influence of sex on the risk of developing childhood overweight/obesity. That is, one study found that the risk of having a greater BMI z-score was significantly higher in boys compared to girls ⁽⁴¹⁷⁾. In contrast, another study found that BMI centile was higher in girls than boys ⁽⁴¹⁶⁾. The third study found

that BMI did not differ significantly between boys and girls, but body fat percentage was significantly higher in girls than boys ⁽⁴¹⁵⁾.

2.4.3 Difficult to modify risk factors

Socioeconomic status and parental obesity are difficult to modify factors that were investigated by the included studies. This is described below.

Socioeconomic status (SES)

Only two of the included studies investigated the association between SES and the risk of developing overweight/obesity in young Saudi children ^(417,423). However, only one study, which was conducted by El-Gamal et al. (2020) found a significant influence ⁽⁴¹⁷⁾. This study investigated the difference in obesity prevalence according to the level of socioeconomic status in children living in the city of Jeddah. North Jeddah is of a high socioeconomic level, while south Jeddah is of a low socioeconomic level. Children living in north Jeddah (high SES) were 2.4 times ($p < 0.000$) more likely to develop overweight and obesity compared to those living in south Jeddah (low SES). The other study, which was conducted by Bassam and Tork (2020) investigated the influence of family income on the risk of childhood overweight/obesity, but no significant association was found ⁽⁴²³⁾.

Parental overweight/obesity

According to this systematic review, only one study investigated the association between maternal BMI and child BMI z-score ⁽⁴²⁴⁾ and found a significant positive correlation ($p = 0.009$).

2.4.4 Modifiable risk factors

The included studies investigated several modifiable determinants of obesity in young Saudi children. These included developmental, behavioural, environmental and nutritional factors, as described below.

Developmental factors

Of the developmental factors, infant feeding practices were investigated by only two studies ^(417,423). However, these two studies reported contrary findings.

The study conducted by Bassam and Tork (2020) found that breastfeeding was a protective factor against obesity in Saudi preschool children ($p=0.02$)⁽⁴²³⁾. This study did not specify the duration or the type of breastfeeding (whether it is exclusive or not). Nonetheless, it was found that a larger proportion of preschool children with healthy weight had received breastfeeding compared to their counterparts with overweight/obesity (23% vs 7%). That is, 23% of children with healthy weight had received breastfeeding, while only 7% of children with overweight/obesity were breastfed. In contrast, the other study by El-Gamal et al. (2020) found a positive association between the longer duration of breastfeeding and child BMI z-score during early childhood ($\beta=0.1$; $p<0.004$)⁽⁴¹⁷⁾.

Behavioural factors

Behavioural factors were only investigated by two studies, and significant associations were reported in both⁽⁴²³⁻⁴²⁴⁾. The association between child eating behaviour and the risk of developing overweight/obesity in young Saudi children was investigated by Al-Hamad et al. (2021). It was found that food approach traits (particularly food responsiveness, emotional overeating and enjoyment of food) were positively associated with higher child BMI z-score during early life years. Conversely, food avoidant traits (particularly satiety responsiveness and slowness in eating) were negatively associated with child BMI z-score⁽⁴²⁴⁾.

The other study, which was conducted by Bassam and Tork (2020), investigated the correlation between childhood overweight/obesity and eating while watching TV behaviour. It was found that eating during TV time was a common behaviour in children with overweight/obesity ($p<0.0001$). The prevalence of overweight/obesity was higher in children who ate during meal times compared to those who did not practice such behaviour (30.2% vs 6.3%). This study also investigated the association between the frequency of daily meals and childhood overweight/obesity. It was found that the proportion of overweight/obesity doubled in children who consumed 4-5 meals/day compared to those who ate 2-3 meals/day (24.6 % vs 11.3%)⁽⁴²³⁾.

Environmental factors

Three studies investigated the impact of environmental factors on the risk of developing childhood overweight/obesity in the KSA during early life years ^(415-416; 423). All three studies found significant associations. However, each study found a significant association with different environmental risk factors. For instance, the study conducted by Heba et al. (2017) identified attendance at a private kindergarten as a risk factor for overweight/obesity in young Saudi children. The prevalence of overweight/obesity was double in children in private kindergartens compared to those attending public ones (30% vs 14%, $p<0.001$) ⁽⁴¹⁶⁾.

Screen time was also identified as a risk factor for obesity young children living in the KSA according to one study which was conducted by Al-Hazzaa and Al-Rasheedi (2007). Children with overweight/obesity spent a longer duration watching TV compared to their counterparts with a healthy weight (197 vs 150 min/d; $p<0.001$) ⁽⁴¹⁵⁾. Finally, the third study which was conducted by Bassam and Tork (2020) identified physical activity as a protective factor against the risk of developing overweight/obesity in young Saudi children. Playing football was associated with a lower risk of obesity ($p<0.05$). Children who played football had a 93% lower risk of developing obesity compared to their counterparts who did not ⁽⁴²³⁾.

Nutritional factors

Of the included studies, three investigated the associations between nutritional factors and overweight/obesity in young Saudi children ^(417,423,425). However, only two studies reported significant findings. The study conducted by Bassam and Tork (2020) found a correlation between diet characterised by high fat and carbohydrate with childhood overweight/obesity ($p<0.0001$). The findings showed that 30% of children with overweight/obesity consumed high fat and carb diets, while none of these children consumed a low fat and carb diet ⁽⁴²³⁾.

The other study, conducted by Mustafa et al. (2021) identified a high intake of animal protein as another determinant ($p=0.001$). That is, daily intake of animal protein was more prevalent in children with overweight/obesity (21.4%)

compared to their peers of healthy weight (8.2%). In addition, a high intake of soft drinks was identified as a risk factor ($p=0.02$). The proportion of children with overweight/obesity who consumed soft drinks frequently (2-6 times/week) was higher than that of their counterparts with a healthy weight (74.8% vs 65%). Additional identified risk factors included frequent intake of chips and crisps ($p<0.005$). The proportion of children with overweight/obesity who consumed chips and crisps frequently (2-6 times/week) was higher than their counterparts with a healthy weight (67.6% vs 56%). In contrast, frequent intake of fruits and vegetables (2-6 times/week) was found as a protective factor against childhood overweight/obesity ($p=0.001$). Frequent intake of fruits and vegetables was more prevalent in children with healthy weight compared to their peers with overweight/obesity (52.4 % vs 32%) ⁽⁴²⁵⁾.

Table 2-1 Characteristics of included studies and prevalence of overweight/obesity in young children living in the KSA

Author/year	Region	Age	Sample Size	Growth Reference/ Method	OW%	OB%	Total OW&OB%	Quality
El-Hazmi and Warsy (2002) ⁽⁴²⁶⁾	Nationwide	1-6 y	1,618	IOTF BMI (OW≥25, OB≥30)	4.6	9.9	14.5	7
Al-Hazzaa and Al-Rasheedi (2007) ⁽⁴¹⁵⁾	West	3.4-6.4 y	224	Body fat % (OB in boys>25%, OB in girls>30%)	-	10.8	-	5
Mouzan et al. (2010) ⁽⁴¹⁰⁾	Nationwide	5-6 y	2,943	WHO 2006 BMI z-score (OW>2SD, OB>3SD)	8.7	2.5	11.2	7
Al-Dossary et al. (2010) ⁽⁴¹¹⁾	East	2-4 y	1875	CDC BMI centile (OW≥85 th , OB≥95 th)	18.1	19.2	37.3	6
El Mouzan et al. (2012) ⁽⁴²²⁾	Regional	2-6 y	2874	CDC BMI centile (OW≥85 th , OB≥95 th)	13.4	5.9	19.3	7
	Central		975		15.9	7.5	23.4	
	Southwest		815		8.2	2.9	11.1	
	North		1084		16.2	7.3	23.5	
Heba et al. (2017) ⁽⁴¹⁶⁾	West	3-6 y	820	CDC BMI centile (OW≥85 th , OB≥95 th)	10.0	15.0	25.0	6

OW (Overweight), OWT/OB (Obese), IOTF (International Obesity Task Force), CDC (Centers for Disease Control and Prevention), WHO (World Health Organisation).

Table 2-1 Characteristics of included studies and prevalence of overweight/obesity in young children living in the KSA (continued)

Author/year	Region	Age	Sample size	Growth Reference/ Method	OW%	OB%	Total OW&OB%	Quality
Bassam and Tork (2020) ⁽⁴²³⁾	North	3-5 y	142	CDC BMI centile (OW≥85 th , OB≥95 th)	9.1	26.1	35.2	5
El-Gamal et al. (2020) ⁽⁴¹⁷⁾	West	Preschool Without specification	748	WHO 2006 BMI z-score (OW>2SD, OB>3SD)	8.6	11	19.6	5
Al-hamad et al. (2021) ⁽⁴²⁴⁾	Central	2-6 y	200	CDC BMI centile (OW≥85 th , OB≥95 th)	18.5	9.5	28	7
Mustafa et al. (2021) ⁽⁴²⁵⁾	South	< 6 y	95	WHO 2007 BMI z-score (OW>1SD, OB>2 SD)	-	-	34.7	5

OW (Overweight), OWT/OB (Obese), CDC (Centers for Disease Control and Prevention), WHO (World Health Organisation).

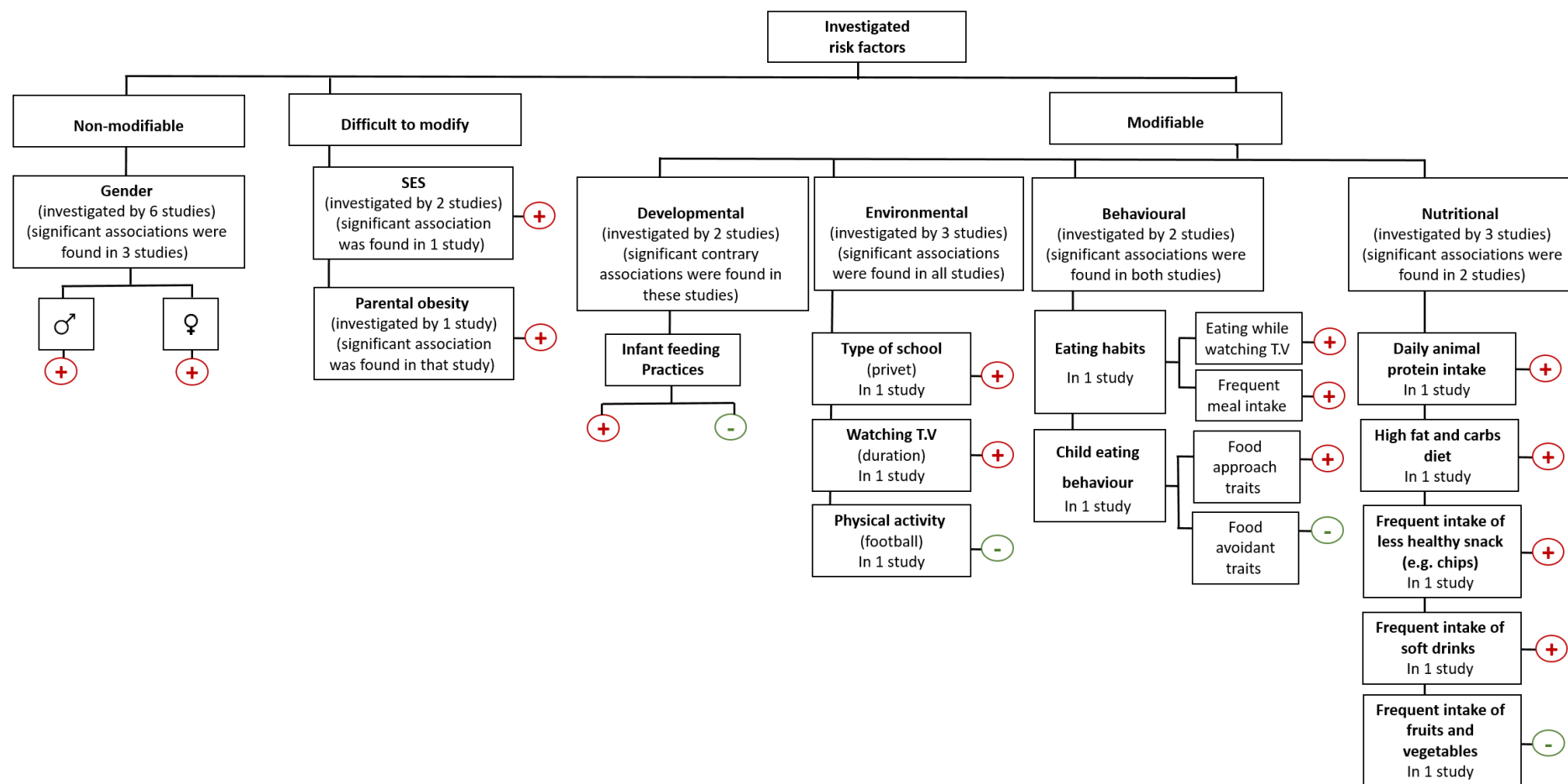
Table 2-2 Risk factors of overweight and obesity in young children living in the KSA

Author/year	Investigated risk factors	Identified risk factors
Al-Dossary et al. (2010) ⁽⁴¹¹⁾	Sex	-
Al-Hazzaa and Al-Rasheedi (2007) ⁽⁴¹⁵⁾	Sex Steps count per/day Duration of watching TV	- Percentage of body fat was significantly higher in girls compared to boys ($p<0.001$) however, BMI didn't differ significantly. - Longer duration of watching TV was reported in children with obesity compared to those of healthy weight (197 vs 150 min/d) ($p=0.001$).
Heba et al. (2017) ⁽⁴¹⁶⁾	Sex Type of school	In private preschools, the prevalence of overweight/obesity was significantly higher than in public ones (30% vs 14%, $p<0.001$). Among girls, the prevalence of overweight/obesity was significantly higher compared to boys ($p=0.01$).
Bassam and Tork (2020) ⁽⁴²³⁾	Sex, childbirth order, family income, family history of overweight, parental education level, employment of mother, parenting style, child eating behaviour and dietary habits, sleep duration, child's favourite activity, gestational obesity, receiving medication during pregnancy, healthy diet during pregnancy and infant feeding practices.	- Breastfeeding was a protective against the risk of overweight/obesity ($p=0.1$). 23.9% of children with normal weight received breastfeeding, while only 7% of children with overweight/obesity received it. - Playing football was associated with a lower risk of obesity ($p<0.05$). Children who played football had a 93% lower risk of developing obesity compared to their counterparts who did not. - Diet characterised by low fat and low carbohydrate was associated with the risk of overweight/obesity ($p<0.0001$). 30% of children with overweight/obesity consumed high fat and carbs diet, while none of these children consumed a low fat and carbs diet (30% vs 0.0%). - Eating during watching TV was associated with a higher risk of overweight/obesity ($p<0.01$). Overweight/obesity was more prevalent in children who ate whilst watching the TV than those who do not eat while watching TV (30.2% vs 6.3%). - Frequent meals throughout the day (4-5 times/d) was associated with the risk of overweight/obesity ($p<0.0001$). Overweight/obesity was more prevalent in children who consume 4-5 meals/d than that in children who consume 2-3 meals/d (24.6% vs 11.3%).

Table 2-2 Risk factors of overweight and obesity in young children living in the KSA (continued)

Author/year	Investigated risk factors	Identified risk factors
El-Gamal et al. (2020) ⁽⁴¹⁷⁾	Sex, SES, family size, parental education, monthly income, maternal employment, gestational period, infant feeding, child dietary habits.	- Obesity was more common among children from areas with high socioeconomic status (OR: 2.43; 95% CI 1.54, p<0.000). - Obesity was higher among males (OR 1.76; 95% CI 1.09, 2.8, p<0.02) compared to females. - The longer the duration of breastfeeding was significantly associated with a higher BMI/Age Z-score ($\beta=0.1$, p<0.004).
Al-hamad et al. (2021) ⁽⁴²⁴⁾	Child eating behaviour	- Maternal BMI was positively correlated with child BMI z-score (p=0.009). - Food approach traits (FR, EF and EOE) were positively associated with childhood overweight/obesity (p=0.02). - Food avoidant scale (SE and SR) were negatively associated with childhood overweight/obesity (p=0.01).
Mustafa et al. (2021) ⁽⁴²⁵⁾	Sex Child dietary habits	- Daily intake of animal protein was more prevalent in children with overweight/obesity compared to their peers of healthy weight (21.4% vs 8.2%; p=0.001). - Frequent intake (2-6 times/week) of soft drinks was more prevalent in children with overweight/obesity compared to their peers of healthy weight (74.8% vs 65%; p= 0.02). - Frequent intake (2-6 times/week) of chips and crisps was more prevalent in children with overweight/obesity compared to their peers of healthy weight (67.6% vs 56%; p= 0.005). - Frequent intake of fruits and vegetables (2-6 times/week) was a protective factor against childhood/overweight/obesity. Frequent intake of fruits and vegetables was more prevalent in children with healthy weight compared to children with overweight/obesity (52.4 % vs 32%; p=0.001).

Figure 2-2 Summary of investigated factors associated with the risk of developing childhood obesity in the KSA



2.5 Discussion

To the best of my knowledge, this is the first systematic review that has focused on the prevalence of overweight and obesity and associated risk factors in young children living in the KSA. Of the 303 studies identified, only 10 were eligible to be included in this systematic review. All of the included studies provided information with regard to prevalence. However, comparison between studies was hampered by different methods used to assess overweight and obesity (different cut-offs on different growth references including IOTF, CDC and WHO) as described earlier, in the results section.

Moreover, half of the included studies (n=5) were more than 10 years old (2002-2012). Most included studies (8/10) were non-representative of the national population in Saudi Arabian children. Only two studies were representative ^(410,426). Nonetheless, the increased prevalence of overweight and obesity in young children living in the KSA is discussed below.

2.5.1 Prevalence of overweight and obesity in preschool children living in the KSA

The two aforementioned older representative studies reported that the prevalence of overweight and obesity in young children living in the KSA ranged between 11.2% to 14.5% ^(410,426). Another older study reported regional differences in such prevalence in the country (across the central, southwest and northern regions). This study found that the southwestern region had the lowest prevalence of overweight and obesity in young children, which was approximately 11% compared to other regions, where overweight/obesity prevalence was nearly 23% ⁽⁴²²⁾. It is possible that such regional differences could be attributed to the different eating habits and dietary preferences within each community.

More recent studies that were conducted during the previous five years across different regions in the KSA, reported that the prevalence of overweight and obesity in young Saudi children is increasing. For instance, in 2021, the prevalence of overweight/obesity reached 34.7% in the southern region ⁽⁴²⁵⁾, while it was only approximately 11% previously ⁽⁴²²⁾. Moreover, in 2020, such

prevalence reached 35% in the northern region ⁽⁴²³⁾, while it was approximately 23% previously ⁽⁴²²⁾. Additionally, the prevalence reached 28% in the central region ⁽⁴²⁴⁾, while it was approximately 23% previously ⁽⁴²²⁾. High prevalence was also reported in recent studies (i.e. since 2017) conducted in the western region reaching 19.6% ⁽⁴¹⁶⁾ and 25% ⁽⁴¹⁷⁾, while it was 10.8% previously ⁽⁴¹⁵⁾.

Overall, it can be concluded that, while there are no recent national studies of obesity prevalence in young Saudi children, five studies have reported regional data in the last five years (2017-2022). Nonetheless, these studies found a high prevalence of overweight and obesity in young children living in the KSA (ranging between 19.6% and 35.2%). This is in line with the high global prevalence of overweight and obesity. For instance, in Kuwait, a neighbouring country to the KSA, the prevalence of obesity in 5-year-old children reached 19% in 2019 ⁽⁴²⁷⁾. In Europe, the prevalence of overweight/obesity in young children was nearly 18% during the period 2006-2016, according to a meta-regression that included data from 26 European countries ⁽⁴²⁸⁾. In the UK, 1 in 5 children under the age of 5 years is either living with overweight or obesity ⁽⁴²⁹⁾.

There are several risk factors for childhood overweight/obesity as described in Chapter 1. However, the current systematic review aims to specifically explore risk factors for obesity in young children living in the KSA. This systematic review identified relatively few studies that primarily investigated determinants of overweight/obesity in young Saudi children (n=4). Other studies (n=3), primarily aimed to describe the prevalence, but also looked at some determinants of obesity. Thus, in total, 7 studies provided information with regards to determinants of overweight/obesity in young Saudi children, including non-modifiable and modifiable risk factors. Of the non-modifiable risk factors, Sex was the only investigated determinant across six of the included studies. As for the modifiable factors, environmental and nutritional factors were the most frequently studied. These were investigated in 3 out of the 4 studies that focused on risk factors. The findings of the present systematic review are discussed in the following sections.

2.5.2 Non-modifiable risk factors

With regard to Sex influence, a higher risk of developing overweight/obesity was detected in young Saudi girls compared to boys, as reported by two of the included studies ⁽⁴¹⁵⁻⁴¹⁶⁾. This is consistent with the literature, in which obesity is globally more prevalent in females compared to males. This could be attributed to the natural differences in body composition found within both sexes ⁽¹⁴¹⁾. Although such an association might not always appear in young children ⁽¹⁴²⁾, the biological differences between both sexes can appear as early as the foetal and postnatal period ⁽¹⁴³⁾. It was reported that female infants have more fat mass and less fat-free mass compared to male infants ⁽¹⁴⁴⁾. However, one of the included studies did unexpectedly report a higher risk of developing overweight/obesity in boys compared to girls ⁽⁴¹⁷⁾. This unexpected finding might be explained by the fact that the study did not control for confounding factors, such as social class and parental weight status. The section below discusses the influence of such factors on the risk of developing overweight/obesity in young Saudi children in accordance with the findings of the present systematic review.

2.5.3 Difficult to modify risk factors

Socioeconomic status

According to this systematic review, children of higher socioeconomic status were at a higher risk of developing overweight and obesity compared with those of lower status. This was reported by one study, which found that the risk of developing overweight/obesity in children of high socioeconomic status was more than doubled compared to those of low socioeconomic status ⁽⁴¹⁷⁾. This is in line with the finding of a study conducted in the city of Riyadh, KSA (found in the central region), which involved 7,930 Saudi schoolchildren ⁽⁴³⁰⁾. This study found a significant correlation between high socioeconomic status and excess weight gain during childhood ($p < 0.0001$). Similar results were reported in a study conducted in the city of Jeddah (western region), which included 393 Saudi children aged between 2 and 18 ⁽³⁷⁴⁾, as well as another study that included 384 Saudi children aged between 3 and 18 years in the same province ⁽⁴³¹⁾. One possible explanation for this association is that high-

income families may provide a more sedentary lifestyle for their children, and may tend to eat out more frequently than children of low-income families ⁽³⁷⁴⁾. Such association was confirmed by the findings of a systematic review of 56 studies conducted in the Middle East, where it was reported that a higher SES could be a predictor of childhood obesity in the region ⁽⁴³²⁾. However, it should be noted that this systematic review did not evaluate the quality of the included studies. Thus, future systematic reviews are recommended to assess the quality of included studies to allow drawing a clear conclusion.

Higher levels of obesity in high SES families within Saudi contrasts with the opposite findings in most Western countries. One explanation for this is that sociocultural factors specific to the region could influence obesity risk. For example, it was reported that a higher education status amongst parents in the KSA is a risk factor for childhood obesity ⁽⁴³³⁾. This might be attributed to the potentiality that educated mothers are more likely to be employed ⁽⁴³⁴⁻⁴³⁵⁾. Accordingly, such employed mothers may have busy schedules and seek assistance from domestic helpers or grandparents ⁽⁴³⁶⁾. This may adversely influence children's dietary habits if the carer holds unhelpful beliefs, including, for example, the concept of 'bigger is better' ⁽³⁹⁶⁾.

Parental overweight/obesity

In one of the included studies, maternal obesity was reported as a risk factor for overweight and obesity in young Saudi children ⁽⁴²⁴⁾. This is in line with the findings of a large-scale study that included data from six European countries. Anthropometric measurements of one or both parents of young children were collected in five countries. The analysis found a significant association between parental BMI and the child's BMI in all five countries ⁽⁴³⁷⁾. This positive association might be explained by the fact that children share the same environment and lifestyle characteristics with their families. The subsequent sections seek to discuss the influence of such factors.

2.5.4 Modifiable risk factors

The present systematic review found that several risk factors were associated with overweight and obesity in young Saudi children. These included developmental, behavioural, environmental and nutritional factors. The findings are discussed in the following sections.

Developmental factors

Two of the included studies investigated the associations between infant feeding practices and the influence of overweight/obesity in young children. However, these two studies reported contrary findings. The first study reported that breastfeeding was a protective factor against the risk of developing childhood overweight/obesity ⁽⁴²³⁾. It was found that breastfeeding was more prevalent among children with healthy weight compared to their peers with overweight/obesity (23% vs 7%). This is consistent with the existing literature, as indicated by previous systematic reviews and meta-analyses ^(184-185; 438). It is suggested that the protective effect of breastfeeding against the development of overweight/obesity could be attributed to the slower growth pattern in breastfed infants compared to formula-fed infants ⁽¹⁹⁵⁾. Further explanation of the potential mechanisms behind such protective effect was discussed in Chapter 1 (Section 1.6.2.3).

The second study, unexpectedly, reported that the risk of obesity in young children was associated with a longer duration of breastfeeding ⁽⁴¹⁷⁾. This is contradictory to the previous literature. However, regardless of the significant difference, that study reported a small effect size in terms of BMI z-score ($\beta=0.1$ points). Nonetheless, the unexpected association reported in this study could be attributed to other unmeasured factors that may mediate such an association. For example, that study did not provide information on the amount or the type of milk formula given to children in addition to breastfeeding, the timing of complementary feeding introduction or its quality. Therefore, further research is required to understand the associations between infant feeding practices in the KSA and the risk of developing overweight and obesity during early life. In addition, environmental factors could play a role in the

development of childhood overweight and obesity, as discussed in the following section.

Environmental factors

According to the present systematic review, the influence of environmental factors on the risk of developing childhood overweight/obesity was investigated in three studies. These factors included physical activity, which was identified as a protective factor against the risk of developing overweight and obesity in young Saudi children by one study. That is, Bassam and Tork (2020) reported that playing football, in particular, was associated with a 93% lower risk of overweight and obesity in young children⁽⁴²³⁾. This is in agreement with expert conclusions based on the 28th European Childhood Obesity Group Congress. It was indicated that traditional sports, such as football, could be considered as part of obesity prevention methods, as it requires whole-body activity and variable body motion, and consequently could maintain energy balance⁽⁴³⁹⁾. It is well known that physical activity plays a role in weight maintenance as it increases energy expenditure⁽⁴⁴⁰⁾.

Another study, which was conducted by Heba et al. (2017), found that children who attended private kindergartens were at a greater risk of developing overweight and obesity compared to their counterparts attending public ones⁽⁴¹⁶⁾. This might be explained by the potentiality of being exposed to an obesogenic environment at the kindergarten. In line with this, a study of 543 Ghanaian schoolchildren attending 14 primary schools reported that attending private schools was associated positively with children's BMI⁽⁴⁴¹⁾. This study reported that the availability of a shop that sells sweets or processed foods in such schools increased the risk of childhood obesity by five-fold ($p=0.003$).

According to the present systematic review, longer durations of screen time was reported as a risk factor of overweight and obesity in young Saudi children, as identified in one of the included studies. Watching TV for more than three hours was significantly correlated with the development of obesity in young Saudi children⁽⁴¹⁵⁾. This finding is consistent with the result of a meta-analysis that included 16 studies of mixed methodological design including cohort, cross-sectional and case reports (the majority were of moderate to high

quality)⁽⁴⁴²⁾. The pooled analysis showed that the risk of developing overweight/obesity in children (<18 years) was ≈ 1.7 times higher ($p < 0.0001$) when screen time exposure was two or more hours per day compared to shorter duration. Additionally, another study that included 526 preschool children found that each additional hour of screen time during a span of four years was associated with a 94% increased risk of developing obesity in 6-year-old children⁽⁴⁴³⁾.

It should be noted that not only were environmental factors identified as an influence, but other behavioural aspects were also seen to have an influence, as discussed below.

Behavioural factors

According to the present systematic review, behavioural factors were associated with the risk of overweight/obesity in young children. Child eating behaviours were identified as determinants of overweight/obesity in one study conducted by Al-Hamad et al. (2021). Food approach traits were found to be associated with obesity risk in Saudi children. These included enjoyment of food (EF), emotional overeating (EOE) and food responsiveness (FR). In contrast to food approach traits, the food avoidant scale was found to be negatively associated with the risk of obesity. Such avoidant scales included satiety responsiveness (SR) and slowness in eating (SE)⁽⁴²⁴⁾. These findings concur with the findings of a meta-analysis that included 27 cross-sectional studies, in which food approach traits were positively associated with higher BMI z-scores in 2-15 year-old children. Conversely, food avoidance traits were negatively associated with child BMI z-score⁽²⁵³⁾.

In addition, the study conducted by Bassam and Tork (2020) identified watching TV during mealtime as a behavioural risk factor for overweight/obesity in young Saudi children⁽⁴²³⁾. The positive association between higher exposure to screen time and the risk of childhood obesity could be attributed to eating behaviours associated with screen time. In support of this, a systematic review, which included 20 studies (most were of moderate to high quality) reported that 75% of these studies indicated a positive association between eating while watching TV and higher risks of childhood

overweight/obesity⁽⁴⁴⁴⁾. Eight of the studies were included in a meta-analysis. The pooled analysis of these studies indicated that the risk of developing overweight was ≈ 1.3 times higher in children who ate while watching TV compared to those who did not.

According to Bassam and Tork's study (2020), a higher frequency of daily meal intake was identified as a risk factor for obesity in young Saudi children. That is, the proportion of overweight/obesity was doubled in children who consumed 4-5 meals/d compared to those who consumed 2-3 meals/d (24.6 % vs 11.3%)⁽⁴²³⁾. This is contradictory to the previous literature, which found a protective effect of increased daily meal frequency against the risk of overweight/obesity⁽⁴⁴⁵⁻⁴⁴⁸⁾. However, the unexpected findings of Bassam and Tork's study⁽⁴²³⁾ might be explained by the quality of diet (e.g. high in fat). This is discussed in the following section, which considers nutritional factors.

Nutritional factors

The rapid increase in obesity in Saudi Arabia can partly be attributed to the rapid nutrition transition, which occurred as a consequence of the discovery of oil in the 1960s. This led to a significant economic shift, which altered lifestyle behaviours, including diet and physical activity among the population⁽⁴⁰²⁾. Increased incomes, urbanization and higher availability of energy-dense foods have all led to diets that are high in saturated fat, salt and refined carbohydrates, but low in fibre. Moreover, traditional diets have been replaced with westernised diets, portion sizes have increased and eating out has become a norm⁽⁴⁴⁹⁾. Thus, in the KSA, people today are living in an obesogenic environment. These dietary changes have coincided with an increased dependence on technological advancements and transportation facilities, which have encouraged sedentary lifestyles and reduced physical activity within the general population. As a result, obesity has increased in all age groups in line with these changes⁽⁴⁵⁰⁾.

According to the current systematic review, three studies looked at the influence of nutritional factors on the risk of overweight/obesity in young Saudi children. However, only two studies found such associations. One study,

conducted by Bassam and Tork (2020), found a correlation between diet characterised by high fat and carbohydrate with overweight/obesity in young Saudi children ⁽⁴²³⁾. The other study found that daily intake of animal protein and frequent intake of less healthy snacks (e.g. soft drinks and chips) were determinants of obesity in young Saudi children ⁽⁴²⁵⁾. Conversely, frequent consumption of fruits and vegetables (2-6 times per week) was associated with a lower risk of obesity in these children. Overall, these findings are consistent with the results of a systematic review that included 16 cross-sectional studies ⁽⁴⁵¹⁾. According to that review, foods that are classified as obesogenic (including snacks, candies, cake and animal products) are associated with the risk of overweight and obesity in children (1-18 years). Conversely, diets classified as healthy (including higher consumption of fruits and vegetables, whole grains, fish, legumes and nuts) is associated with a reduced risk of childhood overweight/obesity.

2.6 Strength and limitations of the current systematic review

The prime strength of the current review is the focus on the early life period within the KSA, as it is considered a vital developmental period for overweight and obesity. To the best of my knowledge, this is the first systematic review that has investigated the prevalence and risk factors of overweight/obesity in young Saudi children. However, there are several limitations that need to be addressed, including the small number of available studies and the small sample size in most studies. In addition, the generalisability of findings is not possible due to a lack of studies that included populations representative of the whole Saudi population. Heterogeneity of the methods used for the assessment of overweight/obesity is another significant limitation.

2.7 Conclusion

Overweight and obesity are prevalent in Saudi Arabian children, but the studies that have sought to investigate the associated risk factors are limited. The findings of this systematic review indicate that high socioeconomic status was associated with overweight and obesity in young Saudi children. Attending private schools, extended screen time and eating while watching TV were

additional determinants. Conversely, structured physical activity was identified as a protective factor. Other risk factors, such as parental feeding styles and food preferences of Saudi preschool children were not investigated. More studies are therefore needed to further investigate the impact of such determinants on the risk of developing overweight and obesity in Saudi preschool children. Based upon these findings, this PhD project aims to investigate potential risk factors for overweight and obesity in preschool years, and to test the feasibility of conducting a culturally-tailored obesity preventative intervention targeting preschool children living in the KSA.

2.8 Recommendations

According to this systematic review, it can be concluded that there are relatively few studies that have investigated maternal feeding practices, such as feeding styles and eating behaviours in relation to overweight and obesity in young Saudi children. Furthermore, little is known concerning the associations between the weight status of Saudi preschool children and dietary aspects, including food preferences, diet quantity and quality. All of these could be factors contributing to childhood obesity and should be investigated. Thus, the first step of this PhD project aims to fill in this gap by studying these risk factors in relation to obesity in Saudi preschool children.

Unfortunately, the KSA and other Arab Gulf countries lack policies that regulate the availability of healthy foods and restrict the selling of less healthy items ⁽⁴⁵²⁾. One study explored current policies that aimed to improve the food environment in kindergartens and schools in Europe. This paper suggested that countries wanting to encourage healthy eating should implement a combination of mutually reinforcing policies together. This included the promotion of nutrition education, the provision of healthy foods and a reduction in the availability of less healthy foods ⁽⁴⁵³⁾. It is recommended that such policies should also be established in Saudi kindergartens and schools to protect child health.

2.9 Chapter Summary

This systematic review found a high prevalence of overweight and obesity among young Saudi children during the last five years (ranging between 19.6% and 35.2%). The risk factors of obesity in young children living in the KSA were investigated by a limited number of studies (n=7). Thus, further investigation of potential risk factors is needed to inform interventions that aim to reduce obesity risk in the KSA. Accordingly, the current PhD project aims to cover this gap by investigating the potential risk factors of obesity in Saudi preschool children. This would inform the development of appropriate obesity preventative interventions in the region. Testing the feasibility of conducting a culturally adapted lifestyle intervention in Saudi preschool children and their families would be the ultimate aim of the current PhD project. Chapter 3 addresses the prevention of childhood obesity and discusses strategies that could be applied in the KSA.

3. Chapter 3: Importance of obesity prevention during preschool years

3.1 Introduction

The previous chapters provided an overview of the overweight and obesity epidemic, its associated risk factors and consequences with details concerning the magnitude of this problem in the KSA. This chapter will provide an overview of the preventative approaches to address childhood obesity. This includes identifying the characteristics of successful interventions and discussing the National Institute for Health and Care Excellence (NICE) guidelines for childhood obesity prevention. This chapter will also consider the appropriate theories and frameworks of interventions for the prevention of obesity in early life, particularly during preschool years. Additionally, cultural adaptation of an existing intervention for the prevention of obesity in young children will be discussed. Thereafter, information on the current situation of obesity prevention in the KSA will be provided.

3.2 Importance and advantages of early obesity prevention

Obesity starts early in life and tracks through childhood into adulthood ⁽⁴⁾. As stated in Chapter 1, childhood obesity is associated with adverse health outcomes ⁽⁴⁵⁴⁾. This includes short-term consequences, such as asthma ⁽⁴⁵⁵⁾, gastroesophageal reflux ⁽⁴⁵⁶⁾, obstructive sleep apnoea ⁽⁵⁷⁾ and higher risk of fractures ⁽⁶¹⁾. Long-term consequences associated with childhood obesity include the persistence of obesity during adulthood. That is, children with obesity are five times more likely to develop obesity during adolescence and adulthood ⁽⁹⁵⁾. Adverse consequences of childhood obesity that could manifest during later childhood and adulthood include type 2 diabetes mellitus ⁽⁴⁵⁷⁾, cardiovascular disease ⁽⁴⁵⁸⁾, hypertension ⁽⁹⁹⁾ and even certain types of cancers ⁽¹⁰⁴⁾. Therefore, obesity preventative interventions in children are likely to be beneficial for health throughout life and are urgently needed.

In addition to health consequences, obesity and related illnesses impose an economic burden on the healthcare system. For instance, according to a NICE economic analysis (2011/2012), the annual healthcare cost of diabetes was

£1.025 billion, of which 47% (£482 million) of the total cost was attributed to obesity. Moreover, the healthcare cost of hypertension was £909 million, of which 36% (£327 million) of the total cost was attributed to obesity ⁽⁴⁵⁹⁾. Therefore, addressing obesity is likely to be cost-effective. This will be discussed later in this chapter.

3.2.1 Why obesity prevention in early childhood is important

The preschool years are a critical period of life that create an opportunity for programming ⁽⁴⁶⁰⁾. The term programming in the field of obesity refers to the long-lasting effects on the susceptibility of developing obesity in response to the exposure of specific early lifestyle and environmental factors ⁽⁴⁶¹⁾. Dietary patterns are established during early life (i.e. preschool years), which can have implications for future health ⁽⁴⁶²⁾. For instance, much of food-preference development, including a craving for sweet foods, occurs during the preschool years. This may occur in response to the obesogenic environment and peers' influence ⁽⁴⁶³⁾. A systematic review that included 18 studies (of moderate to high quality), indicated that sweet food preference is associated with more than twice the risk of developing obesity in children and adolescents (<20 years) ⁽⁴⁶⁴⁾. This highlights the importance of providing a healthy environment that supports the development of healthy food preferences in children.

As opposed to adopting unhealthy dietary habits in early life, establishing healthy dietary habits during preschool years is associated with long-term health benefits during adolescence and adulthood ⁽⁴⁶⁵⁾. For instance, the early and frequent introduction of vegetables increases the acceptance levels of these tastes in adolescence and adulthood ⁽⁴⁶⁶⁾. Such acceptance could be associated with higher intake of such fruits and vegetables, which was found to be a protective factor against obesity ⁽⁴⁶⁷⁾.

As well as programming effects on dietary patterns, the preschool years is the period in which adiposity rebound (a rapid increase in BMI) occurs ⁽⁴⁶⁸⁾. More specifically, adiposity rebound refers to the second highest increase in BMI during early childhood. That is, children experience a fast growth rate during

the first year of life. Following this, the speed of growth starts to slow down gradually, until it reaches its second highest rate during preschool years (2-6 years) ⁽⁴⁶⁹⁾.

Rolland-Cachera et al. suggested that early adiposity rebound (before the age of 5.5 years-old) is associated with a higher risk of developing overweight and obesity during adulthood, in comparison to the later rebound (after the age of 7 years) ⁽⁴⁷⁰⁾. For instance, a retrospective study of 390 subjects had shown that adulthood obesity rates were higher in participants who experienced early adiposity rebound compared to later (25% vs 5%) ⁽⁴⁷¹⁾.

Conversely, others argue that early adiposity rebound is not associated with a higher risk of later obesity during adulthood. In 2004, Cole pointed out that the age of adiposity rebound reflects the degree of BMI centile crossing, which may occur at that time, and he concluded that as a statistical phenomenon, it did not constitute a critical period ⁽⁴⁷²⁾. Nonetheless, it is important to note that adiposity rebound during preschool years might be associated with higher risk of later obesity persistence. That is, obesity may track from early life through later childhood, adolescence and adulthood ⁽⁴⁷³⁾.

Obesity prevention in preschool years is also important because once obesity in this age group is established, it is difficult to reverse ⁽⁴⁷⁴⁾. In one study, it was found that 90% of children with obesity at age 3 years maintained this weight status in adolescence ⁽⁴⁷⁵⁾. As well as the effects on longer term obesity, as mentioned previously, childhood obesity is associated with health problems in adulthood, including cardiovascular disease, type 2 diabetes and even certain types of cancer. Hence, obesity prevention in early life is vital for reducing the risk of developing later obesity and its potential associated health consequences. Benefits of obesity preventative lifestyle interventions for preschool children will be highlighted later in this section.

In addition, prevention of obesity during the preschool years is important because interventions during this period may be particularly beneficial. For example, the most recent Cochrane Review of childhood obesity interventions found that interventions for obesity are most effective if implemented early in

life, and that they should target multiple aspects, such as diet, physical activity and behaviour change ⁽⁴⁷⁶⁾. This might be because altering dietary behaviours during the first five years of life is relatively easier than in older children and adolescents ⁽⁴⁷⁷⁾. This is possibly because dietary behaviours in young children are more malleable than in older children. These children may have either not yet adopted a less healthy lifestyle habits or have not had one for a long duration ⁽⁴⁷⁸⁾. This highlights the fact that preschool years are a critical window for obesity prevention ⁽⁴⁷⁹⁾.

Interventions for obesity during the preschool years seem to be particularly effective with effect sizes of BMI z-score reduction ranging between -0.04 to -0.3 according to previous systematic reviews ⁽⁴⁸⁰⁻⁴⁸²⁾. According to Cohen's interpretation of the effect size, it is suggested that an effect size of 0.2 is small, 0.5 is medium and 0.8 is large ⁽⁴⁸³⁾. However, it is important to note that the interpretation of effect size should be taken with caution depending on the field of the research ⁽⁴⁸⁴⁾. In some fields, small effect size is not meaningful, while in others, even a small size could have a clinical significance. In the field of obesity prevention, although the effect size of preventative obesity interventions is not large, it is nevertheless important. More explanation of this is provided below.

Interventions could be helpful in slowing down the progression of obesity in preschool children. A systematic review that included 58 studies, of which 45 were either RCTs or clustered RCTs (i.e. most studies were at low risk of bias), reported that 54% of children who participated in interventions reduced their BMI compared to their counterparts who were not exposed to the intervention. The effect size of interventions compared to the control groups in terms of BMI reduction was -0.1 kg/m², while it was $\approx$ -0.2 kg/m² at 18-143 weeks follow-up. This review indicated that children in the intervention groups gained less BMI over time compared to control groups ⁽⁴⁸¹⁾. This considerable benefit highlights the importance of investing in obesity preventative interventions.

Obesity prevention in children is also effective from an economic perspective ⁽⁴⁸⁵⁾. For example, a study that used hypothetical cohorts aimed to model the

potential cost effectiveness of lifestyle intervention targeting children with overweight and obesity (10-11 years old). It was predicted that an average reduction in BMI z-score of -0.13 points would roughly increase life expectancy by 0.2 years, while the discounted cost-per-life-year gained is £13,589. Authors reported that these results are broadly similar for interventions aimed at children aged 4-5 years with overweight and obesity ⁽⁴⁸⁶⁾. Another study that focused on preschool children estimated that maintenance of a reduction in BMI z-score of -0.13 points during preschool years would result in a \$301 million healthcare cost-saving over lifetime ⁽³⁴⁾.

In general, the effect size of obesity preventative interventions is smaller than that of treatment interventions ⁽⁴⁸⁷⁾. Reductions of BMI z-score in treatment interventions ranges between -0.4 to $\approx$ -0.5 points according to previous systematic reviews ⁽⁴⁸⁸⁻⁴⁹⁰⁾. The larger effect of treatment interventions on BMI compared to preventative interventions is expected. That is, the impact of obesity preventative interventions is diluted by the inclusion of children with underweight and healthy weight categories. In such cases, maintaining BMI z-score is as important, as reducing BMI z-score in children with overweight/obesity ⁽⁴⁸⁰⁾.

Another plausible explanation for the less pronounced effect of obesity preventative interventions (compared to treatment) is that participants with obesity are more motivated to engage in interventions compared to participants with BMI in the healthy range ⁽⁴⁹¹⁾. This might also be appropriate for parents of children with obesity, who might be more adherent to treatment.

Despite the fact that obesity treatment interventions are likely to result in a greater reduction of child BMI z-score compared to obesity preventative interventions, it is probably better to invest in these preventative interventions, where a small effort would be needed to prevent excess weight gain as opposed to the efforts needed to reduce an already excess gained weight ⁽⁴⁹²⁾. For instance, it has been suggested that an average of only 33 Kcal energy reduction is required to prevent weight gain in children aged 2-5 according to

the previous Healthy People Goal 2020, which is part of the US federal government's prevention agenda for building a healthier nation ⁽⁴⁹³⁾.

In the case of already established obesity, a greater amount of energy reduction and longer duration of time would be needed to reach a healthy body weight. However, the duration and amount of energy reduction needed to reach healthy weight status would be varied according to many factors, including the degree of established obesity, ethnicity and genetics ⁽⁴⁹⁴⁾. It is important to note that detecting specific amounts of energy reduction that is needed to treat obesity is difficult. Most available studies do not show whether a specific amount of reduction in BMI z-score is adequate to reach healthy weight status (i.e. converting from obesity to healthy weight category). However, the example below provides an estimate of the amount of BMI z-score reduction that had been achieved in response to an approximate reduction in the amount of energy intake.

A small RCT conducted by Robson et al. (2019) recruited 151 preschool children with obesity, in which children were assigned either to a multi-component family-based treatment programme, motivational interview or usual care group. Over a six-month period, it was reported that an average energy reduction of 300 Kcal/day was needed to reduce BMI z-score by -0.3 points in children that participated in the multi-component intervention. Participants who were assigned to the motivational interview group had a lower energy intake of 15 kcal/day and lower BMI z-score of -0.05 points and the participants who were assigned to the standard care group (control group) had a lower energy intake of 85 kcal/day, which resulted in reducing BMI z-score by only -0.13 points ⁽⁴⁹⁵⁾.

The example in the previous sections did not indicate whether the reduction of energy intake and subsequent reduction of BMI z-score values had led to reaching a healthy weight status in preschool children with obesity or not. Rather, it simply showed the reduction in child BMI z-score, which was achieved in response to an approximate reduction of energy intake during the treatment process. However, the estimation of energy reduction is not very

precise. That is, the estimation of energy intake was based on analysing data from three random 24-hour dietary recalls (2 weekdays and 1 weekend day). Therefore, it is difficult to detect a precise amount of energy reduction that would be associated with a precise reduction in BMI z-score. In addition, it is important to remember that the amount of energy reduction needed to address childhood obesity may vary according to distinct factors including genetics and ethnicity⁽⁴⁹⁴⁾.

This example mentioned above was provided to demonstrate brief comparisons of the average amount of energy reduction that is suggested to be required for obesity prevention in preschool children when compared to the amount that would be associated with the process of treating obesity. As indicated earlier, 33 kcal deficit/day is suggested to be required for obesity prevention in preschool children, while 300 Kcal deficit/day was associated with reducing BMI z-score by -0.3 points in children with already established obesity. Thus, by looking at the estimated energy deficit associated with the preventative approach compared to process of treatment (33 kcal/d vs 300 kcal/d), it can be concluded that obesity prevention is likely to be easier than treatment (as in accordance to the previous example). Thus, these data further support the concept that it is worth investing in obesity preventative interventions. However, It is important to note that the topic of childhood obesity is sensitive and communication with parents should be carried out respectfully. More details are provided in the section below.

Principles of discussing childhood obesity with parents

Proper interactions between healthcare professionals and families are helpful in terms of influencing parental receptivity to the discussion of child weight status⁽⁴⁹⁶⁾. Hence, it is important for healthcare professionals to consider the best approach to communicate weight status of children with their parents. This, for example, includes using appropriate language and choice of words. Stigmatising children with “obese” should be avoided; instead, describing child weight status in terms of BMI percentile or z-score is a better approach, as indicated by the American Medical Association (AMA) Expert Committee on

the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity ⁽⁴⁹⁷⁾. This aspect was also reported by a scoping review, which included 32 publications and aimed to provide guidance for healthcare professionals with regard to communicating the topic of childhood obesity with parents ⁽⁴⁹⁸⁾. Such review provided further recommendations include raising the topic with an emphasis on child health as the main concern, rather than commenting on body shape and weight.

The principles reported by this review were in alignment with the findings of a qualitative study that aimed to describe parents' preference for how physicians should approach diet and weight-related advice for their preschool children. This qualitative study collected data by interviewing 40 parents ⁽⁴⁹⁹⁾. It was reported that judging parental feeding behaviour should be avoided. Additionally, it was reported that the parental experience of dealing with their children needs to be taken into consideration by healthcare professionals. Many parents find it difficult to discuss childhood obesity in the presence of their children. They prefer if their children were in another room. Also, many parents reported that they want specific and personalised nutritional recommendations for their children. Moreover, the importance of considering the appropriate timing to discuss child weight status with parents was raised by that qualitative study, which stated that parents preferred healthcare professionals to raise the topic of obesity early, as they indicated a preference toward prevention rather than treatment ⁽⁴⁹⁹⁾.

There are different approaches and levels of obesity prevention as discussed below.

3.3 Levels of obesity prevention

Obesity prevention programmes, which can apply to all age groups, are divided into two broad categories. The first category is prevention that targets at an individual level through education and building skills. In the case of preschool children, for individual level interventions, it is important to also target their parents or usual carers, who have a responsibility for providing food and opportunities to be active. Interventions can be delivered to individual

families at home or to groups in preschool or other community settings. This type of prevention programme will be referred to as individual intervention throughout this chapter. The second category targets prevention at the public health level through modification to social policies that reduces the population exposure to the obesogenic environment ⁽⁵⁰⁰⁾. This is also known as a whole system approach.

3.3.1 Public health level interventions

The public health, or population-based approach, is wide and targets the entire community. It aims to reduce the average exposure of the population to common risk factors, rather than modifying factors confined to specific groups ⁽⁵⁰¹⁾. The key advantage of the population-based approach is that it increases the chances of improving health related aspects without requiring deliberate action by individuals, thus providing greater potentiality to improve the public health.

The mechanism of action in public health level interventions relies on the fact that the public health approach takes into consideration that eating behaviour and physical activity of a population are responsive to the surrounding environmental factors ⁽⁵⁰²⁾. A supportive environment is likely to facilitate the adoption of a healthy lifestyle in wider ranges of a population. This may result in a more social acceptability of the new adopted positive change. Once the social norms have shifted to support these healthy choices, maintenance of these behaviours requires less effort from individuals ⁽⁵⁰³⁾.

Imposing taxes on foods that are high in added sugar and saturated fats is an example of an intervention established at population-level ⁽⁵⁰⁴⁾. For instance, according to a systematic review that included 18 studies (more than 70% of which were of medium-to-high quality), a 10% sugar sweetened beverage (SSB) tax was associated with a 10% reduction in beverage purchase and consumption ⁽⁵⁰⁵⁾. Furthermore, according to a model-based study, a 20% tax on SSB was associated with a 7% reduction in individuals with overweight and obesity ⁽⁵⁰⁶⁾. However, a major concern of obesity prevention policies established at the public health level is that the interventions may not be

equally effective among different socioeconomic groups ⁽⁵⁰⁷⁾, leading to inequalities in health.

Public health interventions use a population-based approach aimed at reaching a wider group. However, those who are likely to benefit most from the intervention may not respond ⁽⁵⁰⁸⁾. For instance, a systematic review of 11 articles found that imposing taxes on SSB could be more effective in reducing consumption of people with low socio-economic status ⁽⁵⁰⁹⁾. However, its effectiveness could be attenuated for people of high socio-economic status, who are at greater risk of obesity in developing countries ⁽⁴³²⁾. This highlights the importance of considering interventions implemented at an individual level.

3.3.2 Individual level interventions

As opposed to the public-health level, individual-level interventions focus on the identification of causes of obesity in specific groups of people ⁽⁵¹⁰⁾. Examples include targeting groups with known risk factors for obesity, such as inappropriate feeding practices, unhealthy dietary habits and sedentary lifestyles. In order to reduce obesity rates, appropriate interventions can be developed at individual level to address previously identified risk factors. Targeting specific risk factors may result in more pronounced effects in terms of obesity reduction.

Limitations of an individual approach include higher costs, staff demands and longer duration of implementation ⁽⁵¹¹⁾. However, there are other advantages that may outweigh the disadvantages. These include reducing the gap of inequality in terms of obesity prevalence reduction among different socio-economic status groups ⁽⁵¹²⁾. Another important advantage of interventions at the individual level, is the capability to provide integrated programmes that address multiple aspects of obesity prevention, which is likely to result in better outcome ⁽⁵¹³⁾.

Benefits of interventions at an individual-level also include the utilization of customized strategies and flexibility for modifying the prevention plan as needed throughout the programme ⁽⁵⁰⁸⁾. These key features, taken together,

are the strength matrix of an individual-level approach and believed to result in reducing the risk of obesity. Examples of interventions that have used this approach are given below.

A small home-based intervention that included 10 preschool children, provided mothers with the opportunity to set goals to suit their children's specific needs ⁽⁵¹⁴⁾. These goals included increasing vegetables intake and avoiding watching TV during mealtimes. Strategies were individualized to meet each mother's specific goals that could be achieved within their personal circumstances, abilities and access to resources. Their goals targeted establishing a healthy eating and sleeping routine. Example of such goals include increasing vegetable intake, removing TV from mealtime and setting sleep times. Over one year, the intervention was effective; 9 out of 10 mothers reported successful achievements of their goals. This highlights the effectiveness of using customized strategies in individual-level interventions.

Another example of an effective individual-level intervention is a study that included 96 schoolchildren, who participated in a 10-month lifestyle school-based intervention ⁽⁵¹⁵⁾. The intervention provided individualised face-to-face sessions, as well as parental nutrition education. The intervention was effective in reducing overweight and obesity rates. That is, 32% of children who were overweight reached a healthy weight at the end of the study, while 24% of children with obesity moved to an overweight status.

Additionally, interventions that focus on reducing screen time - either through counselling or health promoting curricula - were shown to be effective. For example, a meta-analysis of 8 RCTs (at low risk of bias) reported that interventions that included children and adults resulted in >4 hrs/week reduction in screen time and a mean reduction in BMI of $\approx -0.2 \text{ kg/m}^2$ compared to the control groups ⁽⁵¹⁶⁾.

To sum up, individual level intervention is important for obesity prevention ⁽⁵¹⁷⁾, while policies are essential facilitators of the process of behaviour change ⁽⁵¹⁸⁾. This is supported by a review of 12 systematic reviews of interventions directed

at both the individual and environmental level. The included studies were of acceptable methodological quality and the review concluded that combined interventions yielded more positive results than those targeting either individuals or populations ⁽⁵¹⁹⁾. It has been suggested that this is because reaching children in different settings with established policies that are supported by the government is very likely to result in a positive influence on individual choices ⁽⁵²⁰⁾.

There are different levels at which an intervention could be carried out. Figure 2-1 demonstrates how complex factors across a range of sectors interact to influence obesity. This supports the idea that preventative interventions need to be comprehensive and target many factors through different sectors, as highlighted by Glickman ⁽⁵²¹⁾. However, it should be noted that the establishment of policies is not an easy and quick task, but rather a long process ⁽⁵²²⁾. Thus, even if targeting at the environmental level (through imposing policies and regulations) was not made, targeting at the individual level is still an effective option and should be continued ⁽⁵²³⁾. In light of this, for the present PhD project, I used an individual level approach to develop and test the feasibility of preventative obesity intervention in preschool children and their families in the KSA. Most importantly, identifying characteristics of effective interventions is of a considerable importance.

3.4 Characteristics of successful obesity preventative interventions at the individual level

Table 3-1 provides a summary of evidence based on the reviews that evaluated obesity preventative interventions targeting preschool children. Overall, multi-component, multi-level interventions with parental involvement were found to be the most effective in reducing obesity. Figure 3-1 provides a summary of different levels that could be targeted by interventions. However, there are different classifications of successful interventions. This includes classification according to setting and number of components, which are discussed in more detail below.

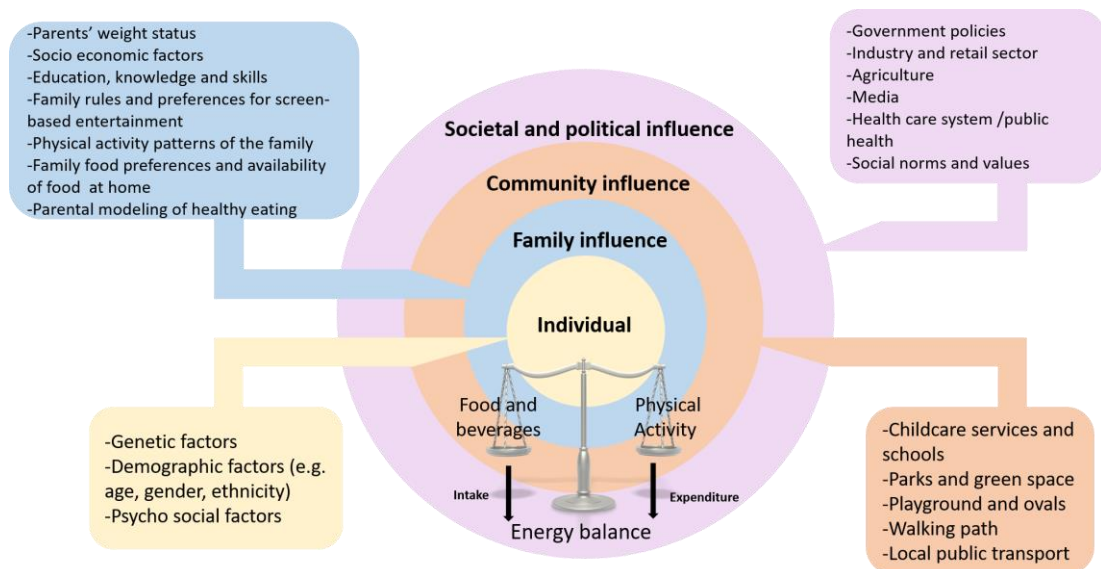
Table 3-1 Summary of evidence from systematic reviews of preschool obesity preventative interventions

Review	included studies(n)	Summary of findings
Saunders (2007) ⁽⁵²⁴⁾	6	Lacks comprehensive evidence of effective strategies to prevent obesity in children under the age of 5.
Bluford, Sherry and Scanlon, (2007) ⁽⁵²⁵⁾	5	Scarcity of findings limits generalizability and highlights the need for evaluated preschool obesity prevention programmes in different settings and racial/ethnic groups.
Campbell and Hesketh (2007) ⁽⁵²⁶⁾	9	All included studies showed some level of effectiveness on at least one obesity-behaviour, but not obesity.
Hesketh and Campbell (2010) ⁽⁵²⁷⁾	23	Suggests that interventions should target behaviours that contribute to obesity in order to promote healthy weight from early childhood.
Bond et al. (2011) ⁽⁵²⁸⁾	4	Suggests future interventions should include cultural sensitivity, moderate to vigorous exercise, parental engagement and both dietary and physical activity components.
Monasta et al. (2011) ⁽⁵²⁹⁾	17	No trial had an effect on preventing preschool overweight and obesity.
Waters et al. (2011) ⁽⁵³⁰⁾	9	Inconclusive evidence for interventions preventing preschool obesity. Meta-analyses found interventions in younger children (0 – 5 years) were more effective in reducing weight (BMI zscore) - 0.26kg/m ² (95% CI:-0. 53, 0.00) compared to older age groups.
Nixon et al. (2012) ⁽⁵³¹⁾	12	Interventions that included parental involvement, interactive learning, physical activity and dietary interventions and long-term follow-up were most effective.
Ling, Robbins and Wen (2016) ⁽⁵³²⁾	23	Challenging to draw definitive conclusions due to the heterogeneity of the included interventions. Suggests that targeting both child and parents through physical activity and nutrition may be more effective in preschool obesity prevention.
Sisson et al. (2016) ⁽⁵³³⁾	71	Interventions to prevent excess weight gain may be most effective when targeting children at greater risk, such as those in higher weight categories. Over 2/3 of those interventions deemed effective (71%) at reducing obesity were developed using behavioural theory.

Table 3-1: Summary of evidence from systematic reviews of preschool obesity preventative interventions (continued)

Review	included studies(n)	Summary of findings
Blake-Lamb et al. (2016) (534)	26	In early life, most current intervention designs are limited to a focus on individual-level diet and activity behaviours, rather than trying to impact the social context that gives rise to these behaviours and upstream influences on obesity.
Blake-Lamb et al. (2016) (535)	7	Multi-component interventions appear to be an effective treatment option for overweight or obesity in preschool children up to the age of 6. However, the current evidence is limited, and most trials had a high risk of bias. Most trials did not measure adverse events.
Ling et al. (2017) (480)	30	Meta-analyses of prevention intervention studies found the pooled effect size was -0.19 kg/m^2 (95% CI: $-0.26, -0.09$), with sustained effects (-0.2 kg/m^2 (95% CI: $-0.35, -0.08$)).
Stanhope et al. (2017) (536)	134	There is no consensus for which tools represent a gold standard or threshold of accuracy.
Scott-Sheldon et al. (2020) (481)	51	Significant reduction on BMI z-score was not achieved. However, 54% of children that participated in interventions reduced their BMI compared to counterparts in control groups.
Yoong et al. (2020) (537)	2	Lifestyle interventions conducted in family day care. Both studies reported a significant positive impact on child dietary habit and physical activity environment
Landgren et.al (2020) (538)	12	Family-based interventions reported on the effectiveness of multi-component interventions for preschool obesity prevention. The review found that current evidence of success for individual elements within multi-component interventions is limited.
Scott-Sheldon et al. (2020) (481)	58	Relative to controls, children that received an intervention had a lower BMI at the end of the intervention ($g=0.1$, 95% CI: $0.02-0.18$). At the last follow-up, BMI was lower ($g=0.17$, 95% CI: $0.04-0.3$); and BMI z-score was lower ($g=0.20$, 95% CI: $0.06-0.3$). Three intervention components moderated efficacy: engage caregivers in praise/encouragement for positive health-related behaviour, provide education about the importance of screen time reduction to caregivers and engage paediatricians/health care providers.
Narzisi and Simons (2021) (539)	30	Engaging parents in attempts to prevent childhood obesity is important. A particularly influential time period appears to be new motherhood, when mothers are receptive to health messages, as exemplified by the studies focusing on infant feeding and weaning practices.

Figure 3-1 Various levels and sectors of influence on obesity in population



This figure is based on Wisham et al. (2007) ⁽⁵⁴⁰⁾

3.4.1 Interventions classified according to setting

Interventions can be classified according to their settings where they take place. These include primary care clinics, home, community and schools or other child-care centres ⁽⁵⁴¹⁾. More details with regard to programmes implemented in each of these settings are provided below.

3.4.1.1 Primary care clinic-based interventions

Primary care clinic-based interventions refer to healthcare that is provided for attendees at primary care clinics by at least one healthcare professional, such as a medical doctor, nurse or dietitian ⁽⁵⁴²⁾. Clinic-based programmes may include motivational interviews ⁽⁵⁴³⁾, goal setting ⁽⁵⁴⁴⁾ and counselling that focus on behavioural change to improve diet and physical activity ⁽⁵⁴⁵⁾.

Children and families generally visit primary care clinics to seek healthcare. This allows an opportunity to identify children who are at risk or already diagnosed with obesity, and subsequently provide them with appropriate management or prevention tools. Hence, primary care is regarded as an

important setting to address obesity in children. A successful example of preschool obesity treatment intervention that was conducted in primary care settings in Sweden is the More and Less study. This RCT included 147 preschool children and focused on improving parenting skills. Children were randomised to join 1 of 3 groups: 1) standard treatment, 2) parent-only training and 3) parent-only training with booster sessions. After one year, the child BMI z-score was reduced by -0.5 points for those who were assigned to the parent-only training with booster sessions ⁽⁵⁴⁶⁾.

One of the key advantages of interventions delivered in primary care clinics is that they are often delivered by healthcare professionals. This is because participants often prefer to contact with healthcare professionals as they are trusted sources of information ⁽⁵⁴⁷⁾. Healthcare professionals work closely with patients and the existing provider relationship with the family may facilitate an effective intervention delivery ⁽⁵⁴⁸⁾.

In support of the effective role of delivering obesity preventative interventions by healthcare professionals, an umbrella review of 12 systematic reviews (with an acceptable methodological quality) investigated the effectiveness of obesity prevention interventions in preschool children. It was found that interventions delivered by experts mostly resulted in positive outcomes ⁽⁵¹⁹⁾. Another systematic review and meta-analysis looked at the effectiveness of interventions addressing obesity in preschool children and included 52 studies, of which 42 were RCTs ⁽⁴⁸⁰⁾. It was found that delivering obesity preventative interventions by healthcare providers was an effective moderator of the pooled reduction in BMI of -0.3 kg/m². However, most of the included studies in this systematic review did not provide sufficient and clear information to assess the risk of bias, which prevented a rigorous quality assessment. Therefore, clear reporting of study methodology is required to provide reliable evidence with regard to the effectiveness of interventions that target preschool obesity and those delivered by healthcare professionals.

The positive role of delivering lifestyle interventions has also been confirmed in a systematic review and meta-analysis, which compared the effect size of interventions delivered by professionals, compared to those delivered by non-professionals. The meta-analysis included 78 RCTs and targeted school children (5-18 years) with overweight and obesity. It was found that professional-led interventions were more effective in reducing child BMI compared to non-professional-led interventions (≈ -0.6 vs 0.01 kg/m^2) ⁽⁵⁴⁹⁾. However, there was a risk of bias in most included studies. Thus, conducting high quality studies is important to allow us to draw clear conclusions with regard to the role of healthcare professionals in delivering childhood obesity preventative interventions.

As stated above, primary care clinic-based interventions have advantages; however, there are also some disadvantages. These include the cost and time for transportation to the clinic, which is likely to be barriers to adherence to treatment or prevention programmes ⁽⁵⁵⁰⁾. In addition, it is important to note that primary care service usually focuses on treatment rather than prevention ⁽⁵⁵¹⁾. The limited number of studies investigating the effectiveness of obesity preventative interventions in primary-care clinics compared to the number of treatment studies has hindered a rigorous evaluation of the programmes' efficacy ⁽⁵⁴²⁾; hence, more research is needed.

3.4.1.2 Home based interventions

Home-based interventions refer to programmes where the intervention is implemented almost entirely within the home. Such interventions often target modifying the home environment and parental behaviours ⁽⁵⁵²⁾. This is because the home atmosphere and parental feeding behaviour are important factors that could promote child health ⁽⁵⁵³⁾. For example, the Healthy Habits, Happy Homes intervention provided parents of preschool children with motivational coaching at home using educational materials ⁽⁵⁵⁴⁾. The intervention lasted for 6 months and resulted in improvements in obesity-related behaviours such as reduced screen time. Additionally, BMI was reduced by -0.4 kg/m^2 with a borderline significant difference ($p=0.05$) in children who participated in the

intervention compared to the control group. However, the sample size was small, in which only 121 families were enrolled.

In terms of overall efficacy, a previous systematic review of six home-based obesity preventative interventions in children aged 2-18 reported that the strength of evidence to support the effectiveness of such interventions is low⁽⁵⁵⁵⁾. Another recent systematic review investigated the effectiveness of home-based intervention targeting 2-12 year-old Hispanic children, and included 9 interventions, of which 6 were of an RCT design. This review reported that there was insufficient evidence in favour of home based obesity preventative interventions⁽⁵⁵⁶⁾.

Several barriers of adherence to home-based programmes might affect efficacy of interventions in such settings. These factors include lack of space, parents' busy schedules⁽⁵⁵⁷⁾ and a discomfort with visitors in the home⁽⁵⁵⁸⁾. Hence, this may preclude some families from home-based programme as a potential option.

3.4.1.3 Community based interventions

In community-based interventions, environmental change strategies are adopted in order to promote health and well-being of a population living in a defined community⁽⁵⁵⁹⁾. These programmes are usually composed of multiple components, such as diet, physical activity and family involvement⁽⁵⁶⁰⁾, and are often delivered by trained staff, health professionals or volunteers⁽⁵⁶¹⁾. Romp & Chomp is an example of a successful community-based intervention that aimed to reduce obesity in preschool Australian children (0-5 years) and included 12,000 participants⁽⁵⁶²⁾. It utilized strategies to raise nutritional knowledge among parents and improve diet and physical activity in families. Over a span of four years, this community-based intervention resulted in a small, but significant, reduction of BMI z-score (-0.04, $p < 0.01$) in children aged 3.5 years old. However, the small effect size of this programme might not be of a clinical importance.

One advantage of community-based programmes is the exhibited spirit of empathy and high motivation in working for the community⁽⁵⁶³⁾. The nature of a community structure offers an opportunity for the public to network, interact and share resources⁽⁵⁶⁴⁾. It is expected that programmes implemented in community settings could stimulate cultural changes by motivating changes in a group of people that share similar characteristics and live in the same society. This could promote the social acceptance of new changes and hence, result in lasting social change⁽⁵⁶⁵⁾.

Limitations of community-based interventions include ethnic inequality; that is, people of ethnic minorities may not benefit from such programmes, possibly due to language barriers or cultural differences⁽⁵⁶⁶⁾. Another crucial limitation is the potential attrition rate from community-based programmes. A systematic review of 13 community-based studies that addressed childhood obesity reported several factors that may lead to attrition. These include parental denial, avoiding social stigma and personal circumstances that hinder adherence to such programmes⁽⁵⁶⁷⁾.

According to a review by Ananthapavan et al. (2019), it was reported that calculation of pooled effect size of community-based interventions in the preschool age groups was not possible because of the insufficiency of data available in the literature⁽⁵⁶⁸⁾. This was consistent with the findings of another systematic review conducted by Wang et al. (2015), which included 147 articles describing 139 interventions of RCT and quasi-experimental design. This review aimed to assess the strength of evidence with regard to obesity preventative interventions and targeted a wider age range of children (2-18 years). However, it was reported that there was insufficient evidence with regard to conducting obesity intervention for preschool children in community settings⁽⁵⁶⁹⁾.

3.4.1.4 Preschool centre based interventions

Children under the age of school entry may attend at preschool centres (e.g. kindergartens). These are considered a suitable venue for conducting childhood obesity preventative interventions. This is because such settings offer regular contact with children for a substantial part of the day ⁽⁵¹⁹⁾. Thus, it is suggested that interventions implemented in these settings could be effective if they promoted physical activity and improved nutrition quality by providing fruits and vegetables and avoiding sugar sweetened beverages ⁽⁵⁷⁰⁾. A systematic review included 22 studies describing 17 interventions, in which the majority were of a cluster RCT design and half were of a moderate quality. The review supported targeting preschool settings for conducting obesity prevention programmes. That is, 61% of studies, which measured weight-related outcomes, reported positive findings in favour of the intervention group compared to controls ⁽⁵⁷¹⁾. Nonetheless, the authors reported that heterogeneity of included studies in terms of operationalisation and reported outcome measures hampered performing a meta-analysis to estimate the effect size of obesity preventative interventions in preschool settings.

Although there is not enough evidence to prove the effectiveness of preschool settings, many interventions conducted there found an improvement in obesity related-outcomes (e.g. BMI, BMI z-score or percentage body fat). A supportive example includes the findings of a systematic review that studied the effectiveness of 15 RCTs conducted in preschool settings, in terms of reducing obesity in preschool children. All of the included studies, with the exception of one, were of cluster RCT design with low risk of reporting bias. This systematic review found a positive effect on obesity related-outcomes in half of these trials, despite the heterogeneity of reported outcome measures ⁽⁵⁷²⁾. Examples of the positive significant impacts of included studies on different obesity related measures are provided below.

One study showed a significant reduction in preschool children's BMI z-score by ≈ -0.2 point, while two studies showed a reduction in BMI of -0.3 and -0.5 kg/m². Another two studies showed a reduction in BMI percentile by -6.2 and $-$

6.7, while an additional two studies showed a reduction of body fat percentage of -1.1 and 2.3%. Waist circumference was also reduced by -0.8 and 1cm in an additional two studies ⁽⁵⁷²⁾. The authors reported that due to the paucity of interventions published in this area, they included studies varying in sample size, intervention strategies, intervention duration and outcome measures. Hence, they recommended to consider narrower inclusion criteria and conduct a meta-analysis in the future when more relatively homogenous studies become available.

Another example of an effective kindergarten-based intervention includes the findings of a study that involved 984 Chinese preschool children and lasted for one year. It composed of a 3-component intervention (initiating a healthy curriculum for children that involved training of kindergarten staff and close collaboration between families and kindergartens). At 12 months from baseline, the children in the intervention group had a lower BMI z-score (-0.3 points) compared to their counterparts in the control group who received usual care ⁽⁵⁷³⁾.

The positive impact of interventions conducted in preschool settings with regard to improving obesity related measures in young children might be attributed to the fact that such settings could offer a great opportunity to improve nutrition related behaviour. This could include an increase in fruit and vegetable intake, as well as a provision of a suitable area for physical activity for preschool children ⁽⁵⁷⁴⁾. Thus, a preschool setting is considered a suitable venue for the implementation of obesity preventative interventions.

There are challenges in the implementation of obesity interventions in preschool settings, including scheduling conflicts with the preschool centre's timetable for activities or lessons ⁽⁵⁷³⁾. Thus, it is important to agree suitable arrangements with the preschool centre to avoid disruption and inconvenience. Another limitation that may weaken the intervention effect is the environment within the preschool centre, which might be unhelpful (e.g. availability of shops selling discretionary foods) ⁽⁵⁷⁵⁾. This highlights the importance of setting

appropriate regulations and policies to support the need to provide a healthy environment in preschool centres.

Even if changing policies and regulations of schools and preschool centres was not possible, the implementation of obesity interventions is likely to be a better course of action than not intervening at all. For instance, a meta-analysis of 33 interventions that targeted children under 18 years found that BMI z-score was significantly lower by -0.1 point in children who participated in an intervention than in children never exposed to intervention ⁽⁵⁷⁶⁾. However, this review was limited by the inadequate methodological quality of some included studies. Thus, high quality studies are needed to provide a clearer conclusion.

Overall, taking the pros and cons into account, it seems that the advantages of implementing obesity preventative interventions in preschool settings outweigh the disadvantages. Furthermore, it is possible that steps can be taken to compensate for disadvantages. Hence, further research to investigate the barriers of establishing a healthy lifestyle intervention in preschool settings is warranted.

Family child-care homes

Family child-care homes services are a cheaper alternative to centre-based childcare (i.e. preschool centres). However, fewer regulations with regard to healthy environments might be available in such settings ⁽⁵⁷⁷⁾. A limited number of studies have investigated the efficacy of interventions conducted in such settings. A systematic review conducted by Yoong et al. (2020) identified only two healthy lifestyle interventions conducted in family day care settings. Neither study found a significant impact of these interventions on children's anthropometric measurements. Despite the absence of any detected significant difference in anthropometric measurements, both studies reported a significant positive impact on child dietary habits and physical activity behaviours. This included eating healthier foods, with more fruits and vegetables and reducing screen time ⁽⁵³⁷⁾. Hence, it may be worth investing in interventions targeted at preschool children attending family child-care homes and encouraging such settings to set proper regulations to improve child

health. More research is required to allow rigorous evaluation of the effectiveness of interventions implemented in family child-care homes.

In brief, it seems that the implementation of such interventions in preschool settings might be more feasible, as children already spend a considerable time attending such places. However, the number of studies conducted in preschool settings are limited. Most studies were of limited methodological quality. Therefore, more rigorous research would be needed to investigate the effectiveness of preschool-centres-based interventions. In addition, it is important to consider addressing challenges and barriers of intervention implementation in preschool settings in order to improve the efficacy of obesity preventative interventions in such settings. The current PhD project aims to test the feasibility of establishing an obesity preventative programme in preschool setting (i.e. Hadekat Al-Tefl Kindergarten). In addition, it aims to explore barriers and facilitators of participating in such programmes from a parental point of view.

3.4.2 Interventions classified according to number of components

Interventions can be classified according to the number of components. For example, some interventions focus on one component (single-component), such as physical activity, while other interventions focus on multiple aspects (multi-component), including physical activity, diet and behaviour change with family involvement⁽⁵⁷⁸⁾. Targeting dietary and physical activity components is considered crucial in achieving energy balance. These interventions aim to ensure that energy intake does not exceed energy expenditure and thus, reduce the risk of developing overweight and obesity⁽⁵⁷⁹⁾.

In addition to targeting diet and physical activity aspects, behaviour change plays an important role in facilitating the adoption of healthy dietary and life style habits⁽⁵⁸⁰⁾. Targeting parents of preschool children could be very helpful in this regard. This is because preschool children are dependent on their parents, who have the greatest influence on their lifestyle and are therefore powerful role models⁽⁴⁷⁸⁾. The section below provides details on the components of interventions that aim to prevent obesity in preschool children.

3.4.2.1 Single component interventions

As mentioned previously, single-component interventions are those that focus only on one aspect (e.g. only dietary or physical activity). The main advantages of using single-component interventions is that they may be less expensive and easier in terms of delivery compared to more comprehensive interventions that target multiple aspects with potential engagement of multidisciplinary team⁽⁵⁸¹⁾. The Movement and Activity Glasgow Intervention in Children (MAGIC)⁽⁵⁸²⁾ and the Mighty Moves Programme⁽⁵⁸³⁾ are examples of studies that only targeted one component, which was physical activity in preschool children. These programmes; however, were not effective in reducing BMI. Furthermore, the most recent Cochrane Review of evidence for the effectiveness of interventions for weight management in children found that interventions that focused on physical activity alone were not effective in reducing weight-related outcomes in preschool children⁽⁴⁷⁶⁾. This is very likely because obesity is a multi-factorial problem and therefore, by targeting only one aspect, it may not be adequate to address the full problem. Instead, obesity is very likely best addressed using multiple components⁽⁵⁸⁴⁾ as indicated by the following section.

3.4.2.2 Multi-component interventions

Multi-component interventions target multiple aspects that influence the risk of obesity, such as diet, physical activity and behaviour change. Many include parental involvement. These interventions are more likely to yield better outcomes in terms of reducing obesity measures (e.g. BMI z score) compared to single component interventions⁽⁵⁸⁵⁾. For example, the Cochrane Review conducted by Brown et al. (2019) found that moderate certainty evidence supports the effectiveness of interventions that targets diet combined with physical activity⁽⁴⁷⁶⁾. This review evaluated the effectiveness of such interventions through 16 RCTs and found a significant reduction in BMI of -0.07 Kg/m² (p=0.01) compared with controls. Moreover, eleven studies provided data on BMI z-score and showed an effect size of -0.11 points in favour of multi-component interventions compared with controls, while single

component interventions did not result in a significant change in BMI or BMI z-score⁽⁴⁷⁶⁾.

The superiority of multi-component interventions over single-component interventions could be that targeting multiple aspects of lifestyle provides a wider scope for intervention. This wider scope could possibly increase the opportunity to improve obesogenic lifestyle behaviours. Such behaviours include dietary habits and physical activity. This may, in turn, improve anthropometric measurements of obesity⁽⁵⁸⁶⁾.

The UK National Institute for Health and Care Excellence (NICE) guidelines support the effectiveness of multi-component interventions that aim to prevent childhood obesity. These guidelines state that such interventions should target diet, physical activity habits, and include behaviour change strategies and parental involvement⁽⁵⁸⁷⁾. Thus, it is recommended to design multi-component interventions that comply with these guidelines in order to reduce obesity risks in preschool children.

The Trim Tots Healthy Lifestyle Programme for preschool children and families is one example of a successful multi-component intervention that was developed in compliance with the UK NICE guidelines⁽⁵⁸⁸⁾. It targeted dietary and physical activity behaviours in a single programme to reduce obesity risk and included family involvement. It also incorporated behaviour change techniques, such as providing parents with guidance on goal settings. The Trim Tots intervention, conducted by Lanigan (2013) had taken place in children's centres in Hertfordshire. It was shown to be effective in reducing obesity risk in two randomised controlled trials. The first trial showed a reduction in child BMI z-score of -0.9 points, while the second trial resulted in BMI z-score reduction of -0.3 points. The combined average effect size of the Trim Tots programme was -0.4 BMI z-score⁽⁵⁸⁸⁾.

The Trim Tots was the only multi-component intervention conducted in preschool settings with evidence of success at this time⁽⁵⁸⁸⁾. For these reasons (i.e. Trim Tots being in compliance with the NICE guidelines and proving effectiveness in reducing BMI z-scores of preschool children), the current

research aimed to test the feasibility of cultural adaptation of the Trim Tots intervention for the Saudi population.

In summary, multi-component interventions that target diet and physical activity through education, counselling and encouraging behaviour change with parental involvement, are more effective in preventing preschool obesity compared with single component interventions. The main components targeted are discussed below in detail, with further explanations on the role of each component provided.

3.4.2.2.1 Dietary aspects of multi-component interventions

Dietary aspects of interventions focus on improving the quality and quantity of food intake ⁽⁵⁸⁹⁾. This involves encouraging participants to consume a healthy balanced diet that includes foods from all the major food groups and in their recommended ⁽⁵⁹⁰⁾. There are many ways to achieve this, including applying a local modification to kindergarten/school canteens or imposing healthy school policies. This may also include increasing the availability of fruits, vegetables and water at the intervention setting ⁽⁵⁹¹⁾. A supportive example includes a systematic review conducted by Kerr et al. (2019) which aimed to critically appraise specific components reported in successful interventions to prevent or treat overweight or obesity in children aged 2-11 years old. This review included 14 RCTs, of which 11 were of a multi-component design. The review found that interventions that provided environmental changes in school and preschool settings, such as changing cafeteria menus or the installation of water fountain, resulted in a reduction of child BMI z-score ranges between -0.1 to -0.2 points ⁽⁵⁹²⁾. Another example includes a multi-component intervention that provided water in kindergartens and found that overweight and obesity was reduced by 3.9% and the BMI z-score decreased by -0.06 points in children aged between 2-8 years who participated in the programme when compared with controls ⁽⁵⁹³⁾.

Dietary components of some interventions include hands-on activities, such as gardening and cooking classes ⁽⁵⁷⁸⁾. There is a shortage in studies that provide hands-on activities like cooking classes, for preschool children in particular.

However, examples of studies targeting a wider age range might be relevant. For instance, a multi-component intervention that included 116 families, provided cooking classes to children (aged 5-12 years old) and their parents/carers, was shown to be effective⁽⁵⁹⁴⁾. It resulted in reducing child BMI z-score by -0.1 points in children of the intervention group compared to controls. The positive effect of cooking classes may be attributed to the potential influence of such classes on children's food preferences, and food-related attitudes⁽⁵⁹⁵⁾. Additionally, a narrative review reported that culinary component of interventions is associated with improving dietary habits in children (5-12 year olds)⁽⁵⁹⁶⁾. This included an increase in the preference and intake of fruits and vegetables.

Interventions may target specific dietary components such as fat consumption⁽⁵⁹⁷⁾. That is, higher intake of fat may be associated with higher risk of developing overweight and obesity in children. This is probably because fat is the most energy dense macronutrient, providing ~9 kcals/gram, while protein and carbohydrate provide ~4 kcals/gram. It is therefore suggested that higher fat intakes could result in a positive energy balance, causing weight gain⁽⁵⁹⁸⁾. Hence, interventions that aim to reduce fat intake via dietary advice or food supplementation might be helpful in reducing obesity risk in children.

Reducing fat intake for the prevention of obesity in preschool children is controversial. A systematic review and meta-analysis of 21 publications found that interventions aimed at reducing dietary fat intake in children aged 2-19 were associated with an average reduction in BMI of -0.1 kg/m²⁽⁵⁹⁹⁾. However, that reduction was not significant and most studies were not of a high quality. Although there is little evidence for the effectiveness of reducing fat intake in terms of preventing obesity in preschool children, it is still important to ensure that preschool children do not consume excess fat⁽⁶⁰⁰⁾. It is also worth considering the impact of reducing fat intake on health. This includes a reduction in the absorption of fat-soluble vitamins such as vitamin D⁽⁶⁰¹⁾, which is important, for example, for bone health⁽⁶⁰²⁾. Hence, compliance with the dietary recommendations for fat intake would be important to protect children's health.

Reducing sugar intake is another important aspect to consider in obesity interventions⁽⁶⁰³⁾. In 2015, the WHO reported that there is moderate evidence to support the effectiveness of reducing sugar intake on decreasing body weight in both children and adults. For instance, the average effect size of 5 RCTs conducted in children was -0.8 kg⁽⁶⁰⁴⁾. Furthermore, a systematic review of 33 studies examined the effectiveness of reducing sugar sweetened beverage intake in children <19 years old. Interventions used different methods, including increasing awareness or changing the regulations of school settings. These interventions resulted in a reduction in BMI z-score ranging from -0.04 to -0.5 points⁽⁶⁰⁵⁾. The variation of the effect size, in which some studies showed larger reduction in BMI z-score compared to others could be attributed to many factors. These include targeting multiple aspects (diet and physical activity), in addition to the implementation in multiple settings (e.g. home and school). However, 76% of the studies were at high risk of bias. Therefore, further research is required to assess the effectiveness of reducing sugar intake on the risk of developing overweight/obesity in children.

Adequate fibre intake was found to be associated with reducing BMI z-score in children under 18 years⁽⁶⁰⁶⁾. That could be mainly attributed to the fact that fibre intake is likely to enhance satiety⁽⁶⁰⁶⁾, and consequently decrease the risk of developing overweight/obesity. Thus, interventions promoting adequate fruits and vegetables intake may be promising. For instance, school-aged children who participated in a programme that provided funds to increase fresh fruits and vegetables intake had a reduced BMI z-score of -0.08 points compared to control group⁽⁶⁰⁷⁾.

In addition, ensuring the consumption of appropriate portion size is another important aspect for achieving energy balance⁽³⁵²⁾. It is important to note that energy balance can be achieved by balancing energy intake and energy expenditure⁽⁶⁰⁸⁾. However, excess calorie intake from food could still result in positive energy balance, which is associated with weight gain⁽³⁵¹⁾. For instance, a lifestyle intervention that targeted 314 preschool children with obesity provided parents with recommendations in regards to appropriate portion size for these children. Over 6 months, the BMI z-score was reduced

by ≈ -0.6 points in children that participated in the intervention compared to children who received standard care ⁽³⁵³⁾. Therefore, consumption of a healthy balanced diet is an important element of obesity prevention.

In brief, targeting nutritional aspects (within the context of multi-component intervention designed) is important to address childhood overweight/obesity. However, high quality studies that focus on preschool children are scarce. Hence, filling this gap would help to draw a clearer conclusion on effective dietary aspects of successful childhood obesity preventative interventions during preschool years. Additionally, it is important to remember that focusing on dietary aspects alone has not shown to be effective in reducing the risk of childhood obesity, but rather, focusing on dietary aspects within the context of multi-component design does. That is, targeting physical activity aspects is also important for multi-component interventions to be effective in addressing obesity in preschool children.

3.4.2.2.2 Physical activity aspects of multi-component interventions

An important element of multi-component obesity prevention intervention includes being adequately physically active. Physical activity is defined as any bodily movement produced by the skeletal muscles that requires energy expenditure ⁽⁶⁰⁹⁾. Current recommendations for preschool children include spending at least three hours a day being physically active, either indoors or outdoors ⁽⁶¹⁰⁾, and to limit screen time to an hour a day ⁽³¹²⁾.

The importance of physical activity in obesity prevention can be explained by the fact that physical activity plays a vital role in energy balance ⁽⁶⁰⁸⁾. Balancing food intake against physical activity could help weight maintenance ⁽⁶¹¹⁾. Conversely, a sedentary lifestyle is associated with lower energy expenditure, which would possibly result in excess weight gain ⁽⁶¹²⁾.

Multi-component interventions may target physical activity aspects in different ways. This includes increasing day-to-day activity and/or providing structured exercise sessions ⁽⁵⁸⁰⁾. For example, the meta-analysis conducted by Ling et al. (2017) included 52 studies, of which 42 were RCTs, confirmed the benefit

of establishing multi-component interventions that provided structured physical activity sessions for preschool children. It was found that preschool children who participated in structured physical activity had significantly greater reduction in BMI compared to those who did not participate in such sessions (-0.44 vs -0.06 kg/m²)⁽⁴⁸⁰⁾. However, sufficient and clear information to assess the risk of bias was not adequately reported in most of the included studies. A further systematic review and meta-analysis of 19 RCTs (moderate to high quality) examined the effectiveness of exercise interventions on weight and other health related outcomes in preschool children. Of these, 10 RCTs were of multi-component design. The meta-analysis found that the effect size of interventions that included an exercise aspect resulted in significant reductions in child BMI (≈ -0.2 kg/m²) compared to a control group that did not receive an exercise component⁽⁶¹³⁾.

Multi-component interventions may target physical activity by providing more suitable environments. For instance, through adapting playgrounds in kindergartens⁽⁶¹⁴⁾. A supportive example is the Tooty Fruity Vegie project, which is a multi-component intervention that aimed to address obesity in preschool children. This was a cluster RCT implemented in 18 preschools over 10 months. Playground areas were adjusted as part of the intervention, in order to encourage more physical activity in children. The intervention resulted in a small, but significant, reduction in BMI z-score (≈ -0.2 points) in children who participated in the intervention compared to the control group⁽⁶¹⁵⁾.

Other multi-component interventions may aim to improve physical activity in preschool children by raising parents' awareness of the importance of physical activity. This aims subsequently to motivate them to adopt a healthy and active lifestyle and encourage them to set goals for healthier lifestyle habits⁽⁶¹⁶⁾. For example, the "AanTafel" intervention was a one-year multi-component programme targeting Dutch preschool children with obesity. The physical activity aspect of this intervention included increasing parents' awareness and provided sessions with individual goals. During the intervention, parents were taught active games that they could play with their children at home. In addition, the intervention provided four physical activity classes for both

parents and children to engage them in an active lifestyle, where they could learn about the kind of activities that would be suitable for children ⁽⁶¹⁷⁾. The intervention included 652 preschool children and resulted in a significant reduction in BMI z-score by -0.4 in 3-5 year-old children assigned to the intervention group compared to their counterparts in the control group ($p=0.01$) ⁽⁶¹⁸⁾.

In addition to altering kindergarten playground space and encouraging parents to set goals to support physical activity in children, multi-component intervention may also focus on targeting recreational activities ⁽⁵⁸⁰⁾, and also training teachers and caregivers in preschool settings on physical activity aspects for young children ⁽⁶¹⁹⁾. A supportive example for this includes a multi-component intervention conducted in 41 preschools involving 709 children and led by trained teachers over 11 months. The intervention provided children with daily 30 minute sessions of physical activity and engaged them in a joyful games and exercise tasks. By the end of the intervention, it was found that BMI z-score was reduced by ≈ -0.6 points in children who participated in the intervention compared to their counterparts in the control group ⁽⁶²⁰⁾. It can be concluded that both dietary and physical activity aspects are important for healthy weight maintenance and obesity prevention. It is also important to note that behaviour change might play a vital role in facilitating the adoption of healthier dietary and physical activity habits. This is discussed in the following section.

3.4.2.2.3 Behaviour change aspects of multi-component interventions

Focusing on behaviour change in children and parents is an important aspect of obesity prevention. This is because weight status is influenced by dietary and physical activity behaviours (e.g. spending long times watching TV, eating while watching TV or frequent consumption of fast foods) ⁽⁶²¹⁾. Thus, techniques employed to change less healthy behaviours are very likely to facilitate replacing less healthy dietary and physical activity habits through the adoption of healthier ones. Sustainable behaviour change is likely to produce long-term benefits and enhance energy balance. This is subsequently expected to assist in addressing childhood obesity epidemic ⁽⁵⁷¹⁾.

The core aim of behaviour change in obesity interventions is to enhance the individual's autonomy and capacity to self-regulate their own dietary and physical activity habits ⁽⁶²²⁾. Although children at preschool age are largely dependent on their parents, the formation of self-autonomy in these children starts to develop during these early years ⁽⁶²³⁾. Self-autonomy is likely to be beneficial to self-regulation. This is because self-autonomy could increase the feeling of responsibility and hence, help children/individuals to internalise intention to regulate behaviour in order to make the desired change ⁽⁶²⁴⁾. Therefore, caregivers and parents are recommended to support self-autonomy/regulation in their preschool children. This can be achieved by the utilisation of behaviour change techniques (BCTs) ⁽⁶²⁵⁾. There are a wide range of BCTs, including 93 different techniques that can be employed to address childhood obesity ⁽⁶²⁶⁾.

Several techniques (e.g. goal setting, barriers identification and reviewing progress in achieving goals) can be employed to promote self-regulation and consequently, behaviour change in children ⁽⁶²⁵⁾. These behaviour change techniques are defined as a replicable component of an intervention designed to alter or redirect causal processes that regulate behaviour ⁽⁶²⁶⁾. It is proposed that techniques and strategies work as enablers of behaviour change by augmenting factors that facilitate behaviour change, or by mitigating factors that inhibit behaviour change. For example, environment restructuring increases the availability of healthy foods and reduces the availability of less healthy food. This often results in higher intake of healthy foods and a reduction of less healthy food consumption ⁽⁶²⁷⁾.

Behaviour change techniques mainly aim to improve obesity-related behaviours (e.g. diet and physical activity), in order to improve energy balance and thus, reduce obesity rates. Some studies evaluated the effectiveness of behaviour change techniques on targeted behaviour(s) (e.g. healthy eating), while others evaluated their effectiveness on the final improvement of obesity measures (e.g. BMI). More details concerning these studies are provided below.

Evaluation of the effectiveness of behaviour change techniques in improving obesity-related behaviours

As mentioned above, behaviour change techniques can be used to improve dietary habits. For example, using behaviour change techniques could help promote vegetable intake. This is supported by a systematic review of 30 studies, which was conducted by Nekitsing et al. (2018). This review identified nine dominant intervention techniques that aimed to increase vegetable intake in preschool children. The BCTs that were identified were: 1) modelling, 2) repeated taste exposure, 3) reward, 4) visual presentation, 5) education, 6) offering children a choice, 7) food service (e.g. increasing availability), 8) pairing (stealth) and 9) variety. Descriptions of these behaviour change techniques can be found in Table 3-2. The review also found that using behaviour change techniques resulted in higher vegetable consumption in preschool children (aged 2-5 years) with a small-moderate effect on vegetable intake ($g=0.4$). Effect sizes were reported using Hedges g (adjusted standardized mean differences), as this measure accounts for differences in measurements of intake (e.g. weight in grams, observations, FFQ score) ⁽⁶²⁸⁾.

Interpretation of the above review should be cautious because it has several limitations. A major limitation of using standardized effect size (Hedges g) is the clinical interpretation of the findings, since a standardised measure of effect size does not relate to a familiar measure (e.g. grams) of vegetables. In addition, there was heterogeneity between the included studies in terms of study design, outcome measure and type of vegetables. For instance, some studies measured vegetable intake by counting the number of pieces eaten, while others calculated the consumption in grams. Also, the included studies were of a weak to moderate quality.

Table 3-2 Description of each behaviour change techniques according to Nekitsing and colleagues' review (2018)

Technique	Brief description
Modelling	Learning through observation. It requires the parents to model eating specific foods to encourage their children to mimic them. Also, modelling can be achieved by using animated video characters to model eating of the target foods
Taste exposure	Opportunity to repeatedly taste the same targeted food for many times. This may range between 2-24 times.
Reward	Encouraging children to eat healthy food by with non-food rewards, such as simply praising.
Education	Teaching about nutritional value to children, parents or/and staff
Visual presentation	Presenting the targeted foods in a visually appealing manner. For example, presenting vegetables in the shape of caterpillars.
Pairing or stealth	Presenting targeted foods with another liked food or flavour. For example, herb dip.
Choice	Allowing children to make a choice from two or more targeted food.
Variety	Offer several types of targeted food. For example, offering different types of fruits and vegetables during snack time.
Food service	Provision of targeted foods (e.g. make it available and accessible).

Behaviour change techniques can also be employed to improve sedentary behaviour. For instance, a systematic review of 7 RCTs that targeted reducing screen time in preschool children identified 11 behaviour change techniques, which achieved an average screen reduction time of 3 hours/week. These techniques were: 1) goal setting, 2) action planning, 3) social support, 4) behavioural substitution, 5) demonstration of the behaviour, 6) behavioural practice/rehearsal, 7) providing information about social and environmental consequences, 8) environmental restructuring, 9) feedback, 10) social reward and 11) self-monitoring ⁽⁶²⁹⁾. Descriptions of such techniques are provided in Table 3-3. It should be noted that most studies were of a low quality, and another limitation is that the findings cannot be generalized to the whole population because fewer than half of the studies included children of a low socioeconomic status. Thus, more high-quality studies that target the whole population are needed to appropriately evaluate the efficacy of behaviour change techniques on reducing screen time in preschool children.

Table 3-3 Description of each behaviour change techniques according to Lewis and colleagues' review (2021)

Technique	Brief description
Goal setting	Set or agree on a goal defined in terms of the behaviour to be achieved.
Action planning	Prompt detailed planning of performance of the behaviour (must include at least one of context, frequency, duration and intensity). Context may be environmental (physical or social) or internal (physical, emotional or cognitive) (includes 'Implementation Intentions').
Social support	Advise on, arrange or provide social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) or non-contingent praise or reward for performance of the behaviour. It includes encouragement and counselling, but only when it is directed at the behaviour.
Behaviour substitution	Prompt substitution of the unwanted behaviour with a wanted or neutral behaviour
demonstration of the behaviour	Provide an observable sample of the performance of the behaviour, directly in person or indirectly (e.g. via film, pictures, for the person to aspire to or imitate) (includes 'Modelling').
Behavioural practice/rehearsal	Prompt practice or rehearsal of the performance of the behaviour of one or more times in a context, or at a time when the performance may not be necessary, in order to increase habit and skill.
Providing information about social and environmental consequences	Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behaviour.
Environmental restructuring	Change the environment in order to facilitate, or create barriers to, the target behaviour (other than prompts, rewards and punishments).
Feedback	Provide feedback on the outcome of performance of the behaviour.
Social reward	Arrange verbal or non-verbal reward if, and only if, there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').
Self-monitoring	Establish a method for the person to monitor and record the outcome(s) of their behaviour as part of a behaviour change strategy.

Evaluation of the effectiveness of behaviour change techniques on reducing obesity measures

In terms of reducing obesity-related outcomes, Ellis et al. (2018) conducted a review of six systematic Cochrane reviews to evaluate evidence based on interventions aimed at treating obesity in children under 18 years. Behavioural change was the cornerstone of effective interventions treating obesity, as indicated by all six high quality reviews, with an average reduction in BMI z-score ranging between -0.05 to -0.3 points⁽⁶³⁰⁾. With regard to young children, the Cochrane systematic review by Brown et al. (2019) had reported that interventions using strategies to change diet and physical activity behaviours were effective in reducing child BMI z-score by -0.11 points⁽⁴⁷⁶⁾.

Another example of the effectiveness of employing BCTs for addressing preschool obesity is the findings of the systematic review and meta-analysis conducted by Ling et al. (2017) that included 52 studies, of which 42 were RCTs. The analysis showed that interventions that used behaviour change techniques were effective for preschool obesity prevention, with a significant reduction in child BMI by approximately $\approx -0.2 \text{ kg/m}^2$ ⁽⁴⁸⁰⁾. However, the quality assessment was hindered by the fact that most studies did not provide sufficient and clear information to assess the risk of bias.

The common behaviour change techniques that were utilised in effective interventions treating children with obesity (aged 2-18 years) were investigated by systematic review of 17 RCTs. Effective interventions were defined as those resulted in a reduction of BMI of $\geq 0.13 \text{ kg/m}^2$ in children who participated in interventions compared to control groups. It was found that environmental restructuring, stress management, prompt action as a role model, general communication skills and providing information on the consequences of behaviour to the individual, were the most effective for obesity management in terms of reducing child BMI⁽⁶³¹⁾. However, this systematic review did not provide a quality assessment for the included studies. To provide a reliable estimate of the magnitude of the effect size of interventions, it is recommended that a quality assessment of selected studies is included. Praising positive health-related behaviour is an additional effective behaviour change technique.

used in obesity preventative interventions for preschool children. The effectiveness of such technique was examined by a systematic review of 51 RCTs, which reported a reduction in child BMI by -0.1 kg/m^2 ⁽⁴⁸¹⁾. Importantly, most of the included studies were at a low risk of bias.

Number of combined BCTs

It is important to consider the influence of combining distinct techniques during the development of an intervention. Systematic reviews have found that a common factor in successful childhood obesity preventative interventions is the inclusion of more than one behaviour change technique ^(547, 631, 635). However, it is important to note that in using a range of techniques, the effectiveness of each one cannot be evaluated. This is because BCTs cannot be isolated from each other. Another important point to consider is that interventions are implemented in very diverse conditions. This could possibly result in different interaction effects ⁽⁶³⁶⁾. Therefore, further research is required to identify which technique or combination of techniques are the most effective for obesity prevention in preschool children.

This PhD project will consider incorporating a combination of behaviour change techniques, reported in effective obesity trials during the development of an obesity preventative intervention for Saudi preschool children and their families. These techniques will include goal setting, barrier identification and review progress achieved in accordance to goals, modelling and environmental restructuring. Another important aspect to consider during the development of successful obesity preventative interventions for preschool children is the engagement of at least one family member. The following section will focus on the role of family involvement in addressing preschool obesity.

3.4.2.2.4 Family involvement aspect of multi-component intervention

Parents are considered as agents of change, especially in obesity preventative interventions that target preschool children ⁽⁶³⁷⁾. This is because parental influence on children is greatest in the early years of their child's life, when

they are considered to be role models. In addition, they are considered as gate keepers, who regulate availability of healthy and less healthy foods at home ⁽⁴⁷⁸⁾. Thus, parental involvement is a vital factor for interventions to be successful. A review by Ball et al. (2017) used the principle of intervention mapping and reported that involvement of parents is crucial for the intervention to show effectiveness in reducing childhood overweight/obesity ⁽⁶³⁸⁾.

In support of this, Ling et al. (2017) in their systematic review and meta-analysis of 52 studies (of which 42 were RCTs), found that the involvement of parents of preschool children (through providing them with behaviour change techniques), was an effective moderator of interventions effectiveness in reducing child BMI with an effect size of -0.3 kg/m^2 ⁽⁴⁸⁰⁾. However, as mentioned previously, quality assessment of these studies was obscured by insufficient data provided by the included studies. A further systematic review of 43 studies aimed to assess the strength of the evidence for the effectiveness of interventions in improving anthropometric outcomes in preschool children. The review used validated study quality assessment tools. It was found that parental involvement improved at least one anthropometric outcome in children. That is, parental involvement resulted in higher scores for healthy eating (+0.15) and physical activity (+0.16) when compared to the absence of parental involvement in interventions targeting preschool children ⁽⁴⁸⁷⁾.

In contrast to this, insufficient parental involvement is seen to reduce intervention efficacy. For example, JolinenKids, a multi-component intervention, was conducted in day-care that aimed to improve dietary habits and physical activity of preschool children (3-6 years). 831 participants were assigned to a cluster randomised controlled trial conducted in 62 day-care facilities from 13 different federal states in Germany. However, no effects were reported for anthropometric measurements, dietary habits or time spent in physical activity. The authors attributed the absence of an intervention effect to insufficient parental engagement. That is, the staff found it difficult to engage parents in the intervention, especially those who had full-time jobs ⁽⁶³⁹⁾. This highlights the importance of designing interventions that provide flexibility for parents to engage in lifestyle interventions. Incorporating technology in

delivering interventions could be an effective suggestion to reach parents with busy schedules.

In light of these findings, the current PhD project aims to implement a pilot multi-component childhood obesity preventative intervention with parental involvement, in the KSA. In order to engage parents successfully, this project will consider identifying possible solutions to overcome barriers of parental involvement in such interventions. Reaping the benefits of the present-day technological advancement might be a helpful suggestion to engage parents with full-time jobs. However, the effectiveness of incorporating technology in this needs to be evaluated. More information concerning this aspect is provided below.

3.5 Incorporating technology in delivering interventions

Internet accessibility has increased recently; in 2021, there were 4.9 billion internet users worldwide compared to 1.1 billion users in 2005 ⁽⁶⁴⁰⁾. Data consumption was estimated to reach 786 terabytes per second in 2021 ⁽⁶⁴¹⁾. Searching through the internet for health information has become widely prevalent between parents ⁽⁶⁴²⁾. A systematic review of 33 cross-sectional studies had indicated that the prevalence of online health information sought by parents of children aged 1-12 years ranges between 52-89% ⁽⁶⁴³⁾. However, quality assessment of included studies were not provided. Thus, future systematic reviews are recommended to assess the quality of included studies to allow a clearer estimation of quality of evidence with regard to using internet for health aspects.

With such internet accessibility, as well as the proliferation of hand-held smart devices, technology usage has become increasingly prevalent ⁽⁶⁴⁴⁾. Hence, communication has become more facilitated. This suggests that a digital platform may be an interesting avenue to carry out obesity prevention interventions, which is considered as part of e-Health approach. The term e-Health first emerged in 2000, since then references to this approach have been greatly increased ⁽⁶⁴⁵⁾. The e-Health term refers to incorporating technological and digital advances into the delivery of health interventions.

Interventions that are based on digital and technological advances are becoming increasingly acceptable ⁽⁶⁴⁶⁾. In support of this, the acceptability of technology-based interventions has been confirmed by a broad review article that included 48 studies concerned with the assessment of using technology in delivering interventions, and targeted educating parents of young children ⁽⁶⁴⁷⁾. Multiple forms of technology were used across studies, including mobile devices, video conferencing and web-based platforms. This is consistent with a systematic review that included 11 studies of RCT and quasi-experimental design, which targeted parents of children aged 1-13 years. More than half of the included studies were of moderate to high quality, and this review reported that smartphone apps and social media were considered as a feasible and acceptable mode of intervention delivery ⁽⁶⁴⁸⁾.

Another systematic review in support of the acceptability of technology-based interventions has identified three qualitative studies, which all looked at users' experience of digital intervention. These papers reported that parents of children aged 5-12 considered participation in digital interventions as affordable and easy to use, since technology had become integrated in their daily lives ⁽⁵⁴⁷⁾. However, due to the small number of qualitative studies, this review did not undertake a critical appraisal. Hence, it is recommended to evaluate the quality of evidence in future studies to allow a better understanding of the enablers to participate in digital based interventions.

It is important to note that there are limitations for interventions based on digital and technological advances. The prime limitation is digital divide (i.e. not everyone has access to the internet) ⁽⁶⁴⁹⁾. Another limitation is the relatively new nature of this field. For example, there is not enough knowledge of the safety assessment ⁽⁶⁵⁰⁾. Moreover, there are an ethical concern regarding the usage of the internet, which may put confidential data at risk of being hacked ⁽⁶⁴⁷⁾. Therefore, more research is needed to provide a better understanding of the optimal method of establishing digital interventions and to provide potential solutions.

Another area of vital concern with regard to interventions based on digital and technological advances includes the potential attrition from such digital based-

interventions ⁽⁶⁵¹⁾. In a systematic review of moderate quality digital interventions, 7 of 11 studies reported $\geq 20\%$ attrition rates ⁽⁶⁵²⁾. This may be attributed to missing mainstay pillars of an effective intervention, such as the presence of a face-to-face communication platform ⁽⁵⁴⁷⁾. However, one possible solution to bridge this gap is to consider using features that allow interaction with other users, including other participants and health professionals. Examples of acceptable digital platforms for intervention delivery that provide interactive features include Facebook ⁽⁶⁵³⁾ and WhatsApp (Facebook, Inc.) ⁽⁶⁵⁴⁾.

These digital platforms allow users to chat, share resources and express comments on shared materials. The systematic review of 11 studies conducted by Zarnowiecki et al. (2020) ⁽⁶⁴⁸⁾, as mentioned previously, pointed out that smartphone apps and social media that facilitate communication were favoured by participants across many studies. It is expected therefore, that social media could serve as a helpful tool that allows participants to share experiences, gain social support and learn from each other ⁽⁶⁵⁵⁾. Hence, it may enhance retentions to digital interventions.

Another possible solution to reduce attrition in digital interventions is to allow direct digital communication with the interventionist ⁽⁶⁵⁶⁾. The digital connection with healthcare professionals is considered as an important factor to enhance participants' engagement ⁽⁵⁴⁷⁾. This is probably because the digital opportunity to be in contact with the interventionist is expected to facilitate the process of asking questions and getting feedback. Thus, this is likely to increase participants' motivation and adherence to digital interventions ⁽⁶⁵⁷⁾. The field of employing digital interventions is still growing, and distinct solutions should be tested to evaluate effectiveness.

Regardless of such limitations, digital interventions offer several advantages. These include fast and broad dissemination of health information and the facilitation of providing up-to-date nutritional recommendations to participants ⁽⁶⁵⁸⁾. Additionally, digital interventions are likely to be cost effective in comparison to face-to-face interventions, which demand the availability of

space and staff ⁽⁶⁵⁹⁾. Another obvious advantage of incorporating technology in delivering interventions is that it allows providing a flexibility of participation for parents with busy schedules who find it difficult to attend face-to-face sessions ⁽⁶⁶⁰⁾.

With regard to the effectiveness of digital based intervention in obesity reduction, adequate evidence is not yet available. This might be attributed to the fact that this is still a growing field. However, digitalized interventions might be promising. Nonetheless, an example of an effective e-Health programme includes the "National e-Health Programme for the Prevention and Management of Overweight and Obesity in Childhood and Adolescence" in Greece. The programme targeted 2,400 participants (aged 2-18 years old) through a web application, which provided personalised guidance and detailed advice to reduce excess weight. Over the span of one year, the programme showed effectiveness in reducing the prevalence of overweight and obesity by 26.7% and 32.1% respectively ⁽⁶⁶¹⁾.

Another systematic review and meta-analysis of 8 RCTs investigated the efficacy of digitalized overweight and obesity interventions targeted children (<18 years old), in which parents or carers were an agent of change. The pooled analysis showed that the BMI z-score decreased by ≈ -0.2 points, and when a sensitivity analysis was applied (by removing an outlying study), the effect size became ≈ -0.3 points ⁽⁶⁶²⁾. However, the quality of the included interventions was generally not high; therefore, these results should be interpreted with caution. Additionally, it should be noted that the age range of children included in these studies was wide (<18 years old) and there was an absence of data that focused on preschool children in particular. Therefore, more research is required to draw a clear conclusion on the effectiveness of digitalized interventions in reducing obesity rates specifically in preschool children.

In addition to the potential reduction in child BMI z-score, digital interventions may result in improving parental anthropometric measurements. For example, a pilot study of six-months digital intervention that targeted preschool children and their families showed a significant reduction in mother's BMI, with an effect

size of -0.5 kg/m^2 ⁽⁶⁶³⁾. This highlights the broad advantages of such interventions, which extended to benefit other members of the family. More research is required to evaluate the effectiveness of digitalized interventions for the whole family.

Digital interventions were further found to improve several obesity-related risk factors. For example, Zarnowiecki et al. (2020) examined the impact of digital obesity prevention interventions targeting parents of children (1-13 years) in their systematic review. It included 11 studies of RCT and quasi-experimental design, in which more than half of them were of a moderate to high quality. In this systematic review, the authors found that the digital interventions through apps or websites were helpful in improving parental nutritional knowledge, feeding behaviour, and an increased availability and accessibility of fruits and vegetables in the home ⁽⁶⁴⁸⁾.

Additional examples of the effectiveness of digital interventions in terms of improving obesity-related behaviours include the findings of a study that involved 718 parents of preschool children. This intervention resulted in a significant improvement of children's dietary habits, including a higher consumption of fruits and vegetables; the score of FV daily frequent intake increased by 0.5 points ⁽⁶⁴²⁾. Time2bHealthy is a further example of effective digital intervention, which targeted 86 parents of preschool children and consisted of an 11-week online healthy lifestyle programme. It resulted in a significant reduction of discretionary food intake by 1.3 times in children of the intervention group compared to their counterparts in the control group ⁽⁶⁶⁴⁾. However, there is a need for more studies that target preschool children, in order to allow researchers to draw a clear conclusion with regard to the effectiveness of digitalized interventions in terms of improving obesity-related behaviours.

Taking all of this into account, with considerations of the advantages and drawbacks of digital-based interventions, it can be concluded that the advantages outweigh the disadvantages. However, there are areas of uncertainty. For example, It is unclear whether relying on technological and digital advances alone could be as effective as providing face-to-face sessions

to address childhood obesity⁽⁶⁶⁵⁾. According to several studies, interventions based only on technology are effective in addressing childhood obesity-related factors, such as improving dietary habits and lifestyle^(642; 666-668). However, these studies did not prove effectiveness in improving children's anthropometric measurements. Conversely, other studies argue in favour of the importance of providing interactive face-to-face sessions for children in order to improve anthropometric measures of obesity in preschool children⁽⁶⁶⁹⁻⁶⁷¹⁾. Accordingly, it might be suggested to incorporate technology as an additional supplement to face-to-face components of interventions targeting preschool children⁽⁶⁷²⁾. However, more research is needed to evaluate to what extent technology can be useful in delivering childhood obesity preventative interventions.

Another area of uncertainty include the optimal 'dose' of digital intervention that is acceptable. Not enough evidence is available in the literature regarding how frequently parents need to be contacted. However, Zarnowiecki et al. (2020) systematic review, which was mentioned previously, referred to the fact that many parents prefer not to receive too frequent digital notifications. It was suggested that receiving information once a week might be acceptable⁽⁶⁴⁸⁾. However, further research is needed to estimate the optimal and acceptable 'dose' of digital interventions that is associated with high retention rate, as well as efficacy.

3.6 Optimal dose of effective childhood obesity preventative intervention

Determining the optimal dose of an intervention that could result in a reduction of childhood overweight/obesity is an important factor to consider during the planning stage of an intervention⁽⁶⁷³⁾. A dose can be characterised by duration, frequency and amount of time. Duration refers to the total period of which participant are exposed to the intervention (e.g. three months). Frequency refers to how often the sessions are delivered over the intervention duration (e.g. a weekly session over three months) and amount of time refers to the length of each intervention sessions (e.g. one hour sessions)⁽⁶⁷³⁾.

Unfortunately, there is not enough data, as of yet, to detect such an optimal dose of effective obesity interventions in the target of preschool children. A systematic review and meta-regression (included 133 studies - RCTs and quasi experiments) was conducted to estimate the optimal dose of interventions needed to achieve significant improvement in weight-related outcomes in children aged 2-18 years ⁽⁶⁷⁴⁾. However, the analysis was unable to determine what this should be. This is because the comparisons between studies were hampered by their heterogeneity, including the wide age range (2-18 years) of participants across the studies. In addition, the inconsistency and the wide variation in reporting on the dose of an intervention within the included studies was another limitation in quantifying the effective dose properly. Thus, the association between intervention dosage and effectiveness in reducing weight-related outcomes was unclear.

Another review of the literature had also pointed out that although multi-component interventions are effective in addressing childhood overweight/obesity, the exact optimal dose of each component is unknown. Thus, they suggested that more research is required for this, particularly in young children ⁽⁵⁴¹⁾. However, a systematic review of 12 family-based obesity preventative interventions, which targeted preschool children, indicated that one common aspect of effective trials was the provision of an intervention for a minimum of 12 weeks, with 45 minutes per session and targeting more than one lifestyle behaviour. Nonetheless, according to that systematic review, current evidence with regard to detecting the optimal dose of successful interventions element is limited and findings should be interpreted with caution due to unclear risk of bias ⁽⁵³⁸⁾.

It can be concluded that there is limited evidence in support of the optimal dose of effective childhood obesity preventative interventions. Hence, further research is required. Accordingly, the current PhD project aims to test the feasibility of lifestyle intervention targeting Saudi preschool children and their families over 12 weeks. The intervention will subsequently be conducted once a week, with 75 minutes interactive face-to-face sessions with preschool children in the kindergarten, while parents would predominantly be contacted

digitally with monthly invitation for attending face-to-face discussion group session at the kindergarten (45-60 minutes per session). In addition to the factors discussed above, guiding interventions by theoretical framework is of considerable importance. This will be discussed in the following section.

3.7 Theoretical Frameworks

From a historical perspective, theory can provide a framework to guide the development of health interventions. Underpinning an intervention by a theory might enable the identification of specific mechanisms that are effective in producing a positive health outcome ⁽⁶⁷⁵⁾. Therefore, guiding an intervention by a theoretical framework was recommended by the UK Medical Research Council ⁽⁶⁷⁶⁾.

In particular, obesity prevention interventions are likely to benefit from using a theoretical framework that is based on understanding risk factors of obesity and consequently, potential solutions to address these factors ⁽⁶⁷⁷⁾. Also, a theoretical framework could use findings from previous evaluations to identify components that are likely to be the most effective ⁽⁶⁷⁸⁾. In the field of obesity reduction, such a framework could include strategies to modify diet and physical activity with incorporating behaviour change techniques.

There is no single, correct or universal theoretical framework for a particular area of study. The area of obesity prevention is complex because of the multifactorial nature of the problem. Thus, it is likely that distinct theoretical frameworks might be required to underpin interventions and provide an understanding of the results ⁽⁶⁷⁷⁾. However, a qualitative review of 35 interventions addressing childhood obesity indicated that there is a paucity of studies that clearly describe how to incorporate theory in the development process of interventions ⁽⁶⁷⁹⁾. Thus, more transparency in describing the practical application of theoretical framework underpinning the development of each intervention is required.

Despite the limited information regarding how to incorporate a theoretical framework in the development of an intervention, understanding the basic

elements of a framework could be helpful in explaining how it might be relevant. Guiding interventions by the Social Cognitive Theory (SCT) and the Transtheoretical Model of Behaviour Change (TTM) might be helpful in addressing childhood overweight/obesity. This suggestion is discussed in the sections below, in which definitions, as well as more information with regard to the basic elements of these theories, are provided.

3.7.1 Social cognitive theory

The Social Learning Theory was first proposed by Bandura in 1962. The basis of the theory was that children learn by observation and imitation ⁽⁶⁸⁰⁾. However, it is not that simple, as even animals learn by imitation. Humans differ through higher cognitive processes, which allow us to understand the results and consequences of actions ⁽⁶⁸¹⁾. To reflect this, the Social Learning Theory was re-labelled as the Social Cognitive Theory (SCT) ⁽⁶⁸²⁾.

SCT describes mediators and mechanisms for behaviour change that can be utilised by researchers in designing interventions ⁽⁶⁸³⁾. It is suggested that SCT is suitable to guide obesity preventative interventions, especially those that target children. This is because child eating behaviour and nutritional knowledge can be acquired through socialisation with others who could become a role model (e.g. parents or caregivers). The modelling aspect of SCT in particular, can therefore play a major role in shaping eating behaviour in children ⁽⁶⁸⁴⁾. According to a systematic review of 12 studies, in which most were of strong or moderate quality, it was found that obesity prevention interventions targeting preschool children that were guided by Social Cognitive Theory and Social Learning Theory, resulted in significant changes in one or more weight status measures (e.g. BMI and BMI z-score) ⁽⁵³¹⁾.

Understanding the constructs of SCT may be helpful in explaining the positive impact of building the intervention according to this theoretical framework. There are several constructs of Social Cognitive Theory: 1) Reciprocal Determinism; (the dynamic interaction between individual intra-personal factors and the environment), 2) Behavioural Capability; (an individual's ability to perform a behaviour in accordance with knowing what and how to do it, such

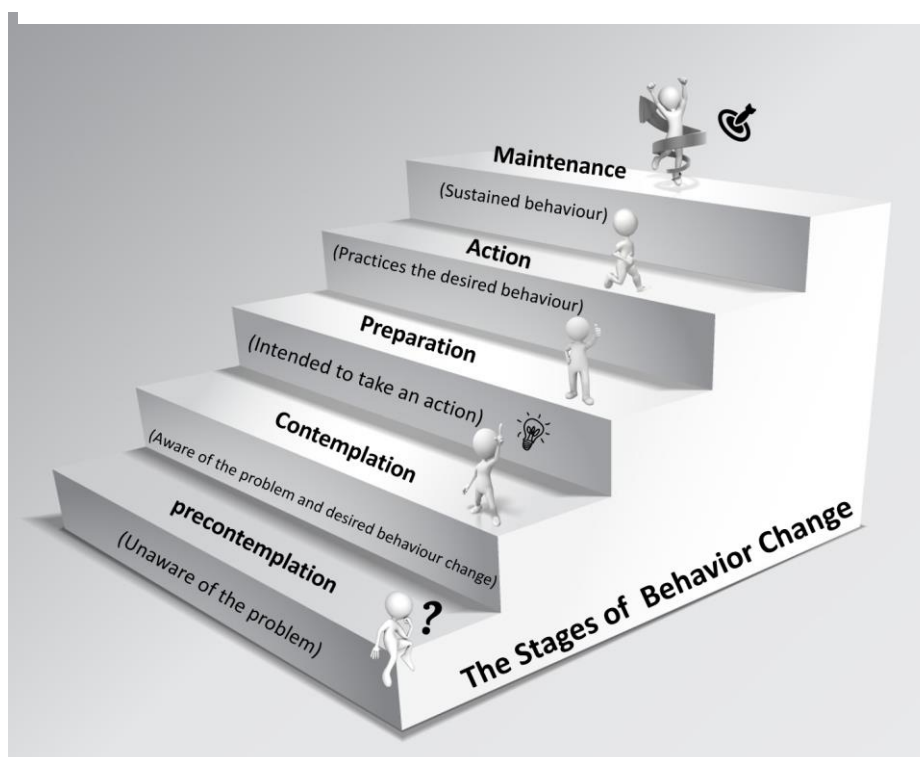
as learning from the consequences of their behaviour), 3) Observational Learning; (observing a behaviour being modeled by others that leads to the reproduction of such behaviour), 4) Reinforcements; (rewards that motivate continuation and replication of the behaviour), 5) Expectations; (the individual's ability to predict results sub-consequent to action) and lastly, 6) Self-efficacy; (confidence to perform a behaviour and overcome challenges) ⁽⁶⁸⁵⁾.

The effectiveness of underpinning an intervention by the SCT, in terms of improving child weight status outcomes, might be attributed to the capability of SCT to influence behaviour change throughout its main construct mentioned above. With regard to the parental component of preventative obesity prevention interventions, using the Transtheoretical Model of Behaviour Change to guide such an aspect might be relevant. More explanation is provided below.

3.7.2 Transtheoretical Model of Behaviour Change

In 1979, Prochaska was the first to introduce a combinable scheme for initiating behaviour modification, which was named the Transtheoretical Model of Behaviour Change (TTM), as reviewed by Pennington (2020). The Transtheoretical Model of Behaviour Change's roots lie in a psychotherapy approach ⁽⁶⁸⁶⁾. Stages of change are the core concept of TTM, and it is these stages that represent the progress from a lower level of success to a higher level of success in achieving behaviour change ⁽⁶⁸⁶⁾.

As illustrated in Figure 3-2, change is a process that progresses over time through five stages: 1) pre-contemplation, 2) contemplation, 3) preparation, 4) action, and 5) maintenance ⁽⁶⁸⁷⁾. During the pre-contemplation stage, participants are not likely to be aware of the importance of making a change, while in the contemplation stage, they acknowledge the existing problem and consider changing behaviour. Preparation is the stage in which participants intend to make a change and may start by the implementation of small changes, while action is the stage associated with considerable effort that fosters overt behaviour change. Finally, maintenance is the stage when participants adhere to the changed behaviour ⁽⁶⁸⁷⁾.

Figure 3-2 The Stages of Behaviour Change

This figure is based on Prochaska, J. O., & DiClemente (2005) ⁽⁶⁸⁸⁾

Previous research suggested that the parental stage of change has an influence on their child's weight status ⁽⁶⁸⁹⁾. Therefore, it is important to take this into consideration during the development of interventions. One suggested method for the implementation of the TTM in interventions is to provide participants with self-help manuals that explain the process of behaviour change ⁽⁶⁸⁶⁾. In such cases, Transtheoretical Model of Change may focus on enhancing the motivation toward behaviour change ⁽⁶⁹⁰⁾. There is a possibility that providing parents with such manuals may increase the motivation toward achieving and maintaining the desired behaviour change successfully. Generating motivation towards behaviour change could be also achieved by the implementation of strategies that stimulate the process of change, including consciousness-raising and environment re-assessment ⁽⁶⁹¹⁾.

Other defining features of the TTM include improvement of self-efficacy and decisional balance. The decisional balance aspect refers to encouraging the participant to evaluate pros and cons (advantages and disadvantages) of the new behaviour. This process could increase participants' awareness of the

advantages of behaviour changes that outweigh the disadvantages. Hence, it could enhance a more positive attitude towards the targeted behaviour by the participants ⁽⁶⁹²⁾. It is further suggested that SMART goals (Specific, Measurable, Achievable, Relevant and Time bound) could foster self-efficacy in participating parents. This could result in improved decisional balance and ultimately an adherence to a new acquired/quitted habit ⁽⁶⁸⁶⁾. These distinct dimensions of the TTM need to be incorporated in obesity preventative interventions.

A systematic review of 21 articles (RCTs and quasi-experiments) indicated that guiding interventions by the TTM is effective in achieving behaviour change in adults (e.g. increase physical activity) ⁽⁶⁹³⁾. However, this review did not provide clear information with regard to the quality of included studies. Thus, interpretation of the findings should be made cautiously. It is recommended that future systematic reviews should provide a quality assessment of included studies, in order to draw clearer conclusions with regard to the efficacy of underpinning obesity preventative interventions by the TTM.

It is suggested that interventions that involve parent-child dyads, which were developed according to both the Transtheoretical Model of Change (TTM) and the Social Cognitive Theory (SCT), could be successful in reducing weight in preschool children, as well as improving parenting skills. Examples of effective parenting skills include praising appropriate behaviours verbally, self-monitoring and implementing daily routines that are centred on eating patterns and exercising ⁽⁶⁹⁴⁾. A small intervention that targeted preschool children included 54 parent-child dyads and ran over 12 weeks. It was guided by the SCT and TTM, and provided a weekly 90-minute, skills-building sessions designed to improve family nutritional habits and increase physical activity. The intervention resulted in a significant reduction of child BMI by $\approx -0.6 \text{ kg/m}^2$ ⁽⁶⁹⁵⁾.

There might be a logical explanation of the potentiality for preventative intervention that is based on both SCT and TTM to be effective in reducing obesity in young children. This includes taking into account the fact that a common factor in effective interventions is to target both children and parents,

as discussed previously. In accordance with this, elements of the Social Cognitive Theory are likely to be effective for influencing behaviour change of a child. In other words, it might be helpful to guide the development of the child component of the intervention by the SCT. Meanwhile, the elements of the TTM could be helpful for delivering the parental component effectively. Therefore, this PhD project aims to develop a pilot intervention in the KSA that is based on the Trim Tots programme and guided by both SCT and TTM.

The above sections (3.1-3.7) have discussed the importance of obesity prevention during early childhood. They have also evaluated the available evidence with regard to childhood obesity preventative interventions with a consideration of several aspects. These sections include information with regard to public health vs individual level, as well as single-component vs multi-component interventions. Moreover, it considered the different potential settings for the implementation of childhood obesity preventative interventions. In addition, they have provided information with regard to the potentiality of increasing parental adherence to intervention by incorporating technology delivery systems. Furthermore, the importance of guiding an intervention by a theoretical framework was discussed and details of possible suitable frameworks to underpin childhood obesity preventative interventions were outlined. The coming sections seek to specifically consider childhood obesity prevention in the KSA.

3.8 Obesity prevention in the KSA

As indicated in Chapter 2, prevalence of overweight and obesity in Saudi Arabian preschool children is dramatically increasing. This prevalence ranges between 19.6% and 35.2% among different provinces during the last five years ^(416-417; 423). Thus, obesity prevention has become a priority in the KSA ⁽⁴¹³⁾. There is a growing interest in implementing obesity preventative interventions in the region ⁽⁶⁹⁶⁾, yet few interventions are available that target school aged children, as indicated below.

A pilot study that targeted 90 girls (9-16 years) provided an educational programme that focused on both nutritional and physical activity aspects. As a

result, the percentage of children with overweight/obesity reduced from 28.9% to 23.3% ⁽⁶⁹⁷⁾. Another intervention targeted 565 girls (12-15 years), who had provided counselling sessions and educational classes about aspects of nutrition and physical activity. As a result, the prevalence of obesity in the intervention group was reduced from 16.3% to 12.9% ⁽⁶⁹⁸⁾. Further intervention targeted 90 school boys (14-15 years) and focused only on improving physical activity ⁽⁶⁹⁹⁾. However, it did not show a significant difference in reducing childhood obesity rates.

Additionally, a cooperation between the Ministry of Health and the Ministry of Education was established in order to control the progress of obesity in school aged children. As a result of this cooperation, the RASHAKA initiative was launched in 2017 ⁽⁷⁰⁰⁾. This initiative aimed to improve lifestyle and dietary habits, as well as raise awareness of the independent risk of obesity among school children. However, evaluation of the effectiveness of this initiative is not yet available.

As described above, the interest towards addressing obesity in the KSA has started to grow. There are attempts to improve dietary habits and physical activity in school aged children in the KSA. However, no intervention has been implemented as of yet to address obesity in preschool children. Therefore, this PhD aims to cover this gap, by developing and testing the feasibility of conducting a healthy lifestyle intervention that targets Saudi Arabian preschool children and their families. The development process of an appropriate intervention is described in the coming section.

3.8.1 Development of a preschool obesity intervention in the KSA

As mentioned in Section 3.2.1, the preschool years are a critical window for implementing obesity preventative interventions, since dietary and lifestyle habits start to develop during this period. However, to date, no multi-component obesity preventative intervention has targeted preschool children and their families in the KSA. Therefore, an appropriate intervention is urgently sought. For the development process, it would be helpful to rely on a previously

tested intervention that proved to be effective. However, it is important to consider the cultural appropriateness of an intervention to ensure acceptability by the local population.

Cultural adaptation of a previously designed programme that complies with the guidelines of obesity preventions during early age, with evidence of success at reducing obesity risk in preschool children (such as Trim Tots), provides a means to address the obesity epidemic the in KSA. As described in Section 3.4.2.2, the Trim Tots was developed in compliance to the NICE guidelines. More importantly, the Trim Tots is currently the only multi-component intervention conducted in preschool settings within the UK that has resulted in a significant reduction in child BMI z-score of -0.4 points. Thus, cultural adaptation of such an existing programme reduces the financial and time burden on research and increases the likelihood of successful intervention. More information with regard to cultural adaptation is provided below.

3.8.2 Cultural adaptation

Cultural adaptation of an intervention refers to modifying and tailoring an existing intervention to make it more suitable and acceptable, either to a new population living in a different country or for different group of people within the same country (e.g. minority groups) ⁽⁷⁰¹⁾. The cultural adaptation process usually takes into account cultural characteristics, such as values, beliefs, attitude, norms and expectancies of a population living in a specific culture ⁽⁷⁰²⁾.

Consideration of cultural sensitivity is a crucial factor when designing a successful and acceptable intervention ⁽⁵³⁹⁾. This is because cultural adaptation makes the intervention more relevant to the targeted audience, which is very likely to enhance acceptability of an intervention. Hence, this is expected to enhance participants' engagement during the intervention. Using methods that are acceptable to and accessible by the local population is important to ensure feasibility of an intervention ⁽⁷⁰³⁾. Thus, this is expected to improve the adherence to the intervention and influence its efficacy ⁽⁷⁰⁴⁾.

Conversely, culturally inappropriate interventions might be confusing, irrelevant and offensive for some ethnic groups ⁽⁷⁰⁵⁾. This may adversely

impact the acceptability and engagement in such intervention. Accordingly, the intervention is less likely to be effective ⁽⁷⁰⁶⁾. Evidence of the importance of cultural adaptation of interventions for preschool children is lacking. However, evidence based on older children (at school age) could be relevant, as supported by the example below.

An example in support of the importance of adapting intervention to suit cultural characteristics of different communities is the findings of a systematic review and meta-analysis of interventions targeting minority school children (6-19 years) in the US. This study included 40 interventions, of which 32 were of RCT design, and almost half of the included studies were of a high quality. The effect size of the included interventions was calculated using Cohen's d. That is, the differences in main outcome measure (i.e., percentage overweight, z-BMI, BMI, or body weight) were calculated for the 32 RCTs. The analysis showed that the effect size of culturally tailored interventions was almost twice the effect size of un-adapted intervention ($d=0.25$ vs $d=0.12$) ⁽⁷⁰⁷⁾. This highlights the crucial role of cultural adaptation of interventions to yield positive results in terms of addressing childhood obesity.

In order to implement a successful intervention in different countries, an appropriate adaptation process of the existing intervention should be undertaken. Such cultural adaptation process considers specific cultural factors and needs of the population in that country ⁽⁷⁰⁸⁾. There are two main stages for appropriate cultural adaptation of an intervention, as described by Stirman and colleagues (2013). These involve 1) modifications to the intervention format and delivery method and 2) modifications to the content of the intervention ⁽⁷⁰⁹⁾. Such modifications are discussed below:

3.8.2.1 First stage of the intervention cultural adaptation process

The first stage of cultural adaptation of an intervention is to ensure that the format and mode of delivery are appropriate and acceptable by the new population who would receive the intervention. To help inform using the appropriate format and delivery methods that would be acceptable to a specific population, it may worth considering the advice of the UK Policy Framework

for Health and Social Care. This framework advises that patient and public involvement (PPI) is important and should be carried out to identify, prioritise and assist in the design of research before it is applied. It is stated that: '(the activity of involving patients, service users or the public in the design, management, conduct or dissemination of research should not be managed as though it is research in its own right)'. In line with this, an umbrella review of 12 systematic reviews of moderate to high quality, reported that interventions driven by user involvement (parents and educators) are of considerable importance for future ⁽⁵¹⁹⁾. This is possibly because involving potential participants in deciding the format and mode of delivery of an intervention may increase their adherence to the programme. More specifically, it is because such intervention would be developed according to their personal preferences.

The format and mode of delivery of an intervention could be modified according to participants' preferences, in which it suits their personal circumstances. For instance, parents of young children who have a full-time job might find it difficult to participate in healthy lifestyle programmes that requires personal attendance. This in turn, might affect the level of adherence to interventions ⁽⁷¹⁰⁾. In this case, exploring potential enablers of participation would be helpful to engage these parents in the intervention. As described in Section 3.5, modifying delivery methods of interventions via the use of technology could be a suitable solution to overcome the time constraint barrier perceived by parents and enhance their engagement in such lifestyle interventions.

3.8.2.2 Second stage of the intervention cultural adaptation process

The second stage of the cultural adaption process is to modify the content of the intervention in which it becomes more appropriate for a specific population. There are several strategies that could be used to help inform deliver the appropriate content. For instance, proper translation that considers using appropriate language and acceptable phrases by the targeted population is one vital factor. However, it is important to stress that simply linguistic adaptation of an intervention content may not be adequate ⁽⁷¹¹⁾. Indeed, there are other strategies that can be incorporated to ensure delivery of culturally

tailored content ⁽⁷¹²⁾. These include tailoring the content of intervention to properly address the roots (causes and risk factors) of the problem ⁽⁷¹³⁾, as described below.

In the field of obesity prevention and management, it is recommended to focus on addressing specific risk factors related to specific targeted groups in order to reduce prevalence of overweight/obesity ⁽⁷¹⁴⁾. Within this context, evidential strategy could be a helpful tool to properly modify the content of an intervention ⁽⁷¹⁵⁾. Evidential strategy relies on utilizing the findings of epidemiological studies that are specific to a given population. Accordingly, it aims to provide evidence-based information to participants in order to increase their awareness of a problem and motivation towards seeking the required change ⁽⁷¹⁶⁾.

Additionally, tailoring the intervention to address barriers and obstacles toward achieving specific targeted behaviour change is expected to increase intervention efficacy in addressing the obesity epidemic ⁽⁷¹⁷⁾. For example, an intervention that aims to address childhood obesity may focus on helping parents to overcome barriers to a healthy lifestyle. Some barriers centre around financial issues, such as a higher cost of healthy items or not having access to physical activity facilities. In this case, providing parents with wise shopping skills and exploring a variety of activities available at low or no cost might be helpful ⁽⁷¹⁸⁾.

Peripheral strategies are an additional method for culturally tailoring an intervention. It refers to using audio and visual elements that are acceptable to and easily recognized by specific ethnic groups (e.g. music, clothes and ethnic foods). Using peripheral strategy is likely to convey relevance to the targeted population and makes materials more acceptable and comfortable ⁽⁷¹⁶⁾. Taken together, distinct strategies might be applied to adapt an existing intervention to become more acceptable for a specific new population. Consequently, this is expected to enhance intervention efficacy.

As indicated by Chapter 2, although obesity is prevalent in Saudi preschool children, no multi-component intervention addressing this epidemic is yet

available. Therefore, this PhD project aims to cover such gap by culturally adapting the Trim Tots intervention, which was conducted in the UK preschool setting in compliance with the NICE guidelines, and proved effective in reducing child BMI z-score with a clinically important effect size.

3.9 Chapter Summary

Childhood obesity has become a worldwide public health crisis. Addressing the problem early in life is important. Specifically, the preschool years are a critical window for obesity prevention. That is, dietary habits are more malleable in young children compared to older ones. Previous studies indicated that prevention is superior over treatment. This is because calories deficit required for prevention are much fewer than that needed for treatment. Thus, prevention requires less time and effort compared to treatment. Accordingly, it is worth to invest in obesity preventative intervention that target preschool children and their families.

The available evidence reported that multi-component interventions that target diet and physical activity with behaviour change and family involvement are superior over single-component interventions. This is probably due to the multifactorial nature of obesity which is likely to be resolved as a result of the interaction of multiple relevant aspects. It is suggested that preschools, where children spend a considerable amount of time, are considered a suitable avenue for hosting such interventions.

There are; however, areas of uncertainty. For instance, the current evidence was unable to detect the optimal dose of interventions that is necessary to produce an improvement on child anthropometric measurements. However, based on existing data, it is suggested that interventions might be effective in reducing weight-related outcomes in preschool children if conducted for a minimum duration of 12 weeks, provide 45 min per session and target more than one aspect of behavior change. Further research is needed to confirm the optimal duration, number of sessions and length of these sessions for an intervention to reduce obesity risk in preschool children.

In the UK, Trim Tots is an example of a successful multi-component intervention. It complies with national guidance for childhood obesity prevention and targets diet, physical activity and behaviour change. The programme involved 24 sessions provided to parents and their children. The first 12 sessions covered different topics around optimum nutrition and a healthy lifestyle. Art and play were used to familiarise the participants with distinct nutritional aspects. The participants also received booklets and presentations explaining such aspects. They also ate healthy snacks and engaged in music and movement sessions together. The remaining 12 meetings were provided as consolidation sessions.

The TrimTots intervention was evaluated in using 2 RCTs and found to be effective in reducing child BMI z-score with a good effect size (-0.4 points). However, in the KSA, there are no multi-component interventions that target preschool children and their families. Therefore, a cultural adaptation of the Trim Tots intervention was planned to address this unmet need. This is important because implementing a culturally appropriate intervention helps in increasing the acceptability of the intervention and promote subsequent efficacy. The process of cultural adaptation would require modifications to the format and mode of delivery of the intervention to meet the requirements of the Saudi public.

These modifications include translating the educational material from English to Arabic. Also, it is planned to use audio and visual materials as well as relevant examples of Saudi food that are well-known to the population living in the KSA. It is also, expected that incorporating technology in delivering part of the intervention might be helpful to increase adherence. Hence, carrying out patient and public involvement exercise and a qualitative study to investigate the most preferable mode of delivery of an intervention in the KSA would take place. Moreover, it is important to acquire an adequate understanding of the risk factors of preschool obesity in the KSA to provide more relevant content to participants which may help address the roots of the problem. To fulfil this, a cross-sectional study was designed. Accordingly, the content of the intervention would be further edited. Testing the feasibility of culturally adapted

intervention for obesity prevention in Saudi preschool children and their families would be the ultimate aim of this PhD project.

4. Chapter 4: Research aims and hypothesis

4.1 Introduction

It has become clear from the previous chapters that studies addressing preschool obesity in the KSA are scarce. The lack of knowledge with regards to risk factors for obesity in Saudi Arabian preschool children limits health workers' and policy makers' management decisions. Early lifestyle interventions are one of the most effective ways in reducing childhood obesity rates, especially since medical treatments are not available for young children. However, there is no intervention to-date that address this problem during the preschool years in the KSA. Therefore, this PhD project aims to fill the current gaps in the literature regarding risk factors for preschool obesity, and the implementation of lifestyle intervention in the region by using a mixed-methods approach. This PhD project includes four studies (cross-sectional, qualitative, intervention adaptation and pilot randomised control trial). The aims and hypotheses of each study are described below.

4.2 Study 1: A cross-sectional study (the risk factors study)

Aim

This study aimed to investigate risk factors associated with overweight and obesity in Saudi Arabian preschool children.

Hypothesis 1

Less healthy diets (e.g. fast food which is high in saturated fat, high protein and low fruits and vegetables) are associated with a higher risk of developing overweight and obesity in preschool children living in the KSA.

Hypothesis 2

Certain child eating behaviours (e.g. food approach traits) and infant feeding are associated with a higher risk of developing overweight and obesity in preschool children in the KSA.

Hypothesis 3

Less active lifestyles (e.g. increased screen time) is associated with a higher risk of developing childhood overweight and obesity in the KSA.

4.3 Study 2: Qualitative research**Aim**

This study aimed to gain in-depth information concerning barriers to adopting healthy habits in the KSA and to investigate enablers of participation in a lifestyle intervention conducted in the region.

Hypothesis 1

Specific characteristics of Saudi culture (e.g. providing large quantities of dense-energy foods as a part of the hospitality norms) influence the development of childhood obesity.

Hypothesis 2

The climate and resultant lifestyle in the KSA restricts physical activity in preschool children.

Hypothesis 3

Incorporating technology in delivering a lifestyle intervention is acceptable to the Saudi population.

4.4 Study 3: Cultural adaptation of the Trim Tots healthy lifestyle intervention for preschool children**Aim**

This study aimed to adapt the Trim Tots intervention to make it more suitable for Saudi families and for Saudi culture characteristics.

4.5 Study 4: Feasibility of a healthy lifestyle intervention that aims to reduce the risk of obesity in Saudi preschool children.

Aim

This study aimed, primarily, to evaluate the feasibility of conducting a healthy lifestyle intervention in Saudi preschool children using a pilot RCT design. This would be helpful to inform whether the intervention can be tested in full efficacy RCT.

Hypothesis 1

Conducting a culturally adapted healthy lifestyle intervention in the KSA is feasible and acceptable to mothers, preschool children and kindergarten staff.

Hypothesis 2

It is possible to conduct an RCT in the study population to test whether the healthy lifestyle intervention has the potential to improve dietary intake and reduce the risk of overweight and obesity in Saudi preschool children.

5. Chapter 5: General Methods

5.1 Introduction

This chapter sets out the methods used in this PhD project. This includes providing details on study design, population, recruitment, randomisation, measurements and statistical analyses.

5.2 Study design

The present thesis used mixed methods to investigate risk factors and evaluate the feasibility of an intervention to reduce the risk of obesity in preschool children and their families. 4 studies were conducted as described in the previous chapter. The methods used in each study are provided in the following sections.

5.3 Study 1: A cross-sectional study to determine the risk factors of preschool overweight and obesity in the KSA.

5.3.1 Population and location

Participants were preschool children (3-6 years) attending the "Hadekat Al-Teff" private kindergarten in the city of Makkah (in the western province of the KSA) and their mothers. This kindergarten was chosen as it is located in the centre of Makkah (and hence provided a logistically convenient study population) and a large number of Saudi children attend (n=323). Thus, it could meet the recruitment target of the study.

5.3.2 Sample size estimation

No previous study has investigated the risk factors for obesity in preschool children in Makkah. Therefore, using an opportunistic survey was a convenient option. The sample size estimation (n=150) was based on a similar study carried out in the United Arab Emirates (UAE). The UAE is a neighbour country that shares many characteristics with the KSA ⁽⁴²⁰⁾.

5.3.3 Inclusion and exclusion criteria

Children of Saudi nationality aged between 3-6 years were eligible to participate in this study. Children who did not meet these criteria were not eligible to participate.

5.3.4 Recruitment

Contact details of mothers were provided by the participating kindergarten. Mothers were contacted by the researcher (myself) and invited to attend a meeting at the kindergarten. At this meeting, the study, entitled “Healthy Living” was explained to the mothers using the Patient Information Sheet (PIS) (Appendix C). Mothers of children who met the eligibility criteria were provided with a copy of that sheet for their own records. They were given the opportunity to ask questions and discuss anything that was not clear to them. Interested mothers were provided with a consent form (Appendix D) and advised to discuss this with family and friends. Each mother was given ample time (at least 24 hours) to consider the study and whether she and her child wanted to take part.

5.3.5 Data collection

Participating children who were attended Hadekat Al-Tefl kindergarten were recruited and measured between 6:30 am to 2:30 pm of week days. This study ran between December 2018 and September 2019. All anthropometric measurements were carried out using Standard Operating Procedures developed by the UCL GOS ICH Childhood Nutrition Research Centre (CNRC) and in accordance with local operating procedures at Umm Al-Qura University and "Hadekat Al-Tefl" Kindergarten at the KSA. Mothers completed questionnaires about social characteristics, child eating behaviour, food preferences and physical activity. All questionnaires were translated into Arabic by myself and can be found in Appendix E. More details on the types of data collected are given below.

5.3.5.1 Social characteristics

Sociodemographic data relating to ethnicity, social class and household structure were collected from mothers with a standardised data collection form used in previous studies conducted within the CNRC. In addition, data on parents' marital status and age were collected. Data on the educational status of parents was also collected and categorised as 'with university degree' vs 'without university degree'.

5.3.5.2 Developmental factors

Mothers were asked to recall information on their child's birth weight (BW). Breastfeeding practices and time of complementary feeding introduction were investigated using a questionnaire developed by Azzeh (2017) ⁽⁷¹⁹⁾. This questionnaire has been previously tested on a relevant sample (n=814), including Saudi mothers from Makkah.

5.3.5.3 Dietary Data

Food frequency questionnaire (FFQ)

Data on children's usual (habitual) dietary intake was collected using a modified food frequency questionnaire (FFQ) adapted from an existing validated questionnaire developed by Jarman et al. (2014) ⁽⁷²⁰⁾ (Appendix E). The original questionnaire was previously validated and tested on a large sample size of preschool children (n=892) at the age of 3 in the UK. The adapted questionnaire used for the present study was modified to suit the cultural characteristics and religious guidelines of the Islamic religion, which is the majority religion that is practiced within the KSA. For example, eating pork is not allowed for Muslims; hence, it was replaced by halal meat. Then, the questionnaire was translated into Arabic (the local language) by myself. The FFQ was used to estimate diet over the preceding three months. The researcher asked how often in the last three months the child had consumed each food and beverage items. The response options were never, less than once per month, 1–3 times per month, number of times per week (1–7) or more

than once per day. If a food was consumed more than once per day, the number of times was recorded.

Data from the FFQ was then used to calculate a healthy plate variety score (HPVS), following the methodology described by Jones et al. (2015) ⁽⁷²¹⁾. Accordingly, food items were allocated to one of the main food groups (Carbohydrate, Fruits, Vegetables, Meat/Fish and Dairy). The number of servings in each food group was totalled. The group score was then calculated by dividing the actual number of daily serving intake by the recommended daily number of servings. To ensure variety, group score was truncated at 1. Such truncation was performed to ensure that a high intake of one food group could not compensate mathematically for a low intake in another group. To calculate the final HPVS, the five food group scores (after truncation) were summed, with a potential maximum score of 5.0 ⁽⁷²¹⁾.

Food preference

Food preference was assessed using a modified version of a questionnaire developed by Fildes et al. (2014) ⁽⁷²²⁾. The original questionnaire was previously tested on a large sample size (n=2,686) of 3 years-old children from the Gemini study, a prospective longitudinal cohort study conducted in the UK. The 70-item questionnaire incorporated questions evaluating preferences of the five main food groups (Carbohydrate, Fruits, Vegetables, Meat/Fish and Dairy), in addition to commonly eaten convenience snacks and foods (e.g. ice cream, chocolate, biscuits and fast foods). The prime modification was to ensure the suitability of the questionnaire's content to the Muslim community, including the replacement of prohibited meats with halal options. Mothers were asked about their children's food preferences using a 5-point Likert scale that ranged from (dislike a lot - likes a lot). "Has never tried" is coded as missing. Each score of food preference scale was calculated by summing each single food preference item score within the specific food category and dividing this sum by the total number of items in each category ⁽⁷²²⁾.

5.3.5.4 Behavioural data

Child eating behaviour

Child eating behaviours were assessed using a validated questionnaire developed by Wardle et al. (2001) ⁽²⁴⁴⁾ and previously tested on 131 children between 2-7 years in the UK. The questionnaire included 35 items and was designed to evaluate eating behaviour in preschool children. It included eight subscales, four of which measure behaviours collectively termed food approach behaviours: 1) enjoyment of food, 2) food responsiveness, 3) emotional overeating and 4) desire to drink. The remaining four subscales measured food avoidant behaviours: 1) slowness in eating, 2) satiety responsiveness, 3) emotional undereating and 4) food fussiness. The questionnaire was translated into Arabic by myself. Mothers were asked to rate each behaviour using a 5-point Likert scale (ranging from Never to Always) to indicate how often children practised the behaviour. In each case, the response options were “My child never does; My child rarely does; My child sometimes does; My child often does; My child always does.” Scale scores were obtained by calculating the means of the items comprising each scale (the sum divided by the number of items in each scale).

5.3.5.5 Parental feeding style

Parental feeding styles were assessed using a validated questionnaire developed by Wardle et al. (2002) ⁽⁷²³⁾. This questionnaire was tested on 214 families. The 27-item questionnaire examined four scales: 1) emotional feeding (e.g. I give my child something to eat to make him feel better when he is upset); 2) prompting and encouragement to eat (e.g. I praise my child if s/he eats what I give her/him); 3) instrumental feeding (e.g. I reward my child with something to eat when s/he is well-behaved) and 4) control over eating (e.g. I decide how many snacks my child should have). The questionnaire was translated into Arabic by myself. Mothers were asked to rate each feeding style using a 5-point Likert scale (ranging from Never to Always) to indicate how often parents practised the behaviour. In each case, the response options were “I never do; I rarely do; I sometimes do; I often do; I always do.” Scale

scores were obtained by calculating the means of the items comprising each scale in which the sum is divided by the number of items in each scale ⁽⁷²³⁾.

5.3.5.6 Physical activity and sedentary behaviours

Physical activity and sedentary behaviours (Defined by watching TV) were assessed using a questionnaire developed by the Born in Bradford study team ⁽⁷²⁴⁾ which was chosen because the population of that study included multi-ethnic preschool children. Home environments were assessed using a questionnaire based on Alturki, Brookes and Davies, (2018) ⁽⁷²⁶⁾. Questions addressed: 1) whether there was adequate space inside or outside the home to allow children to play actively, 2) the usual mode of transportation used by the family (e.g. car vs walking), 3) the time children spent participating in playing actively or watching TV).

Mothers were specifically asked to 1) provide information about the type of activities their children usually engage in; 2) the number of days per week their children engaged in each activity type and 3) the duration spent on each activity. The data collection of screen and physical activity (PA) time was applied in accordance with the data dictionary of the BiB study ⁽⁷²⁴⁾. The coding system of the data collection for PA and screen time was as follows; 1) up to 15 mins/day, 2) 16 to 30 mins/day, 3) 31-60 mins/day and 4) more than one hour ⁽⁷²⁴⁾. However, since the data was not linear, I analysed the dichotomised data into two variables: 1) time spent more than 1 hour/day or 2) less than 1 hour/day.

5.3.5.7 Anthropometry

Obesity was assessed using non-invasive and harmless methods to measure body size (Figure 5-1). Body measurements were taken using standardised equipment according to standard operating procedures. Children's height and weight were measured using a mechanical combined scale and stadiometer (Detecto). Calibration was checked by a technician before taking the measurements. Height was measured to the nearest 0.1cm with the child barefoot and wearing minimal clothing. Weight was measured and recorded to the nearest 0.1kg. BMI was calculated by dividing the weight in kilogrammes

by the height in meters squared. Standard deviation scores (z-scores) for weight, height and body mass index were calculated using WHO growth data as described below. Waist circumference was measured to the nearest 0.1cm at the narrowest girth of the waist using a non-stretchable tape measure. Children were asked to breathe normally, and measurements were taken at the end of a normal expiration. Weight and height of mothers were measured for most (n=98) and, for mothers who did not want to be measured, self-reported (n=52).

Overweight and obesity classification

In children younger than 5 years, overweight and obesity were assessed by using BMI z-score system and values were compared to the growth standards developed by the WHO (2006). A programme known as “Anthro plus” was used to calculate the children’s BMI-z score. The cut off for overweight classification was +2 SD, while the cut off for defining obesity was +3 SD. In older children (5-6 years), overweight was defined as +1SD, while obesity was defined as +2SD according to the WHO 2007 growth reference. With regards to mothers, BMI between 25 and 29.99 kg/m² was used to classify overweight, while a value at or above 30 kg /m² was used to classify obesity according to the WHO weight status classification (2000).

5.3.6 Ethical consideration and data protection

The study protocol was reviewed and approved by the research ethics committees at UCL and the Umm-Al-Qura University, Medical Sciences College in the KSA. The reference for the ethical approval obtained for this PhD project is PE017. Data collection forms were held in a locked building and department, and electronic data was stored on password-controlled computers, with each file password-protected. Data were pseudonymised. All data collected (including on computers) were identifiable by a number only and the identifying codes were kept separate in a secure location. Data collection and storage procedures at the UCL GOS ICH Childhood Nutrition Centre and Medical Sciences College are entirely compatible with the General Data Protection Regulations, 2018.

Figure 5-1 Instruments used for anthropometric measurements



From left to right: non-stretchable tape and mechanical combined scale and stadiometer (Detecto).

5.4 Study 2: Qualitative study to investigate mothers' perceptions of childhood obesity and potential barriers or enablers to participation.

The method of this study is reported in accordance to the consolidated criteria for reporting qualitative research (COREQ) checklist.

5.4.1 Population and location

Mothers of Saudi preschool children attending the Hadekat Al-Tefl Kindergarten who were eligible to participate in the lifestyle intervention (Healthy Living study). Participants are likely to be of high SES, as they are chosen from a private kindergarten. It is noteworthy to emphasize that both prevention and treatment of obesity in young children require lifestyle intervention to address the problem. This is because medical or surgical treatments are not available for this age group. Thus, the present intervention was designed to help prevent preschool obesity, as well as to treat existing obesity. Nevertheless, we wished to confine the intervention to children who were already overweight or at increased risk of obesity to test the feasibility of this intervention in a relatively high-risk group. The intervention does not encourage weight loss in preschool children, but aims to improve lifestyle and eating habits to slow the rate of weight gain and protect long-term health.

5.4.2 Sample size estimation

In qualitative research, there is no specific formula to calculate the appropriate sample size. However, researchers in the field of qualitative research were consulted and they agreed that the sample size for qualitative research can be detected when saturation level is reached. Saturation is the situation wherein no more new themes emerge. Previous research suggests that a small number of interviews could be adequate to reach saturation. For instance, Guest et al. ⁽⁷²⁷⁾ analysed 60 interviews and concluded that 12 in total are adequate to achieve sufficient saturation in research aiming to understand common perceptions and experiences of a relatively homogeneous group. This is supported by other studies in the field of qualitative research ⁽⁷²⁸⁻⁷³⁰⁾. Thus, in

the present study, 12 interviews were considered as the minimum sample size and more participants were recruited until saturation was reached. Reaching saturation level was achieved after collecting 24 interviews, and this was discussed with the research assistant.

5.4.3 The inclusion and exclusion criteria

The inclusion criteria were:

- Mothers of Saudi children aged 3-6 years attending the Kindergarten for the 3-month intervention.
- Mothers of children with overweight or obesity (based on BMI for age and sex according to WHO growth charts, as described previously in Section 5.3.5.7) or at increased risk of obesity (one or both parents are with overweight/obesity).

If inclusion criteria were not met, potential participants were excluded.

5.4.4 Recruitment

A contact list of mothers with children eligible to participate in the 'Healthy Living' intervention and the research was obtained from the administration of the kindergarten. The nurse provided a random list of contact details of potentially eligible participants. Mothers were then contacted directly by me and their eligibility in the study confirmed. These mothers were initially approached either face-to-face (when they dropped their children at the kindergarten or picked them up) or by telephone if they did not drop off/pick up their children themselves). There was not a relationship established prior to the commencement of the study between the researcher and the participants. The study was explained to mothers using another participant information sheet (Appendix F). It was explained to them that this study is linked to another one (i.e. the pilot RCT, as indicated in Section 5.6). It was also explained to these mothers that this study was being conducted as part of a PhD project, with an emphasis on the rationale and aim of such research.

Mothers were invited to take their time to read the information, discuss with family and friends, as well as ask any questions. They were provided with a copy of the information sheet for their own records. Interested mothers were provided with a consent form (Appendix G). The consent form was fully explained, and mothers were allowed enough time (at least 24 hours) to consider participating in the intervention.

It is important to note that the recruitment process aimed to collect 30 participants in order to cover the sample size of the other study that was linked to this one (see Section 5.6). Both studies (the qualitative research and the pilot RCT) were explained to mothers using the same PIS (Appendix F) and consent form (Appendix G). In total, 41 mothers were invited to participate. Of these, 11 (27%) declined, while 30 (73%) agreed to participate. Those mothers who declined to participate did not provide any clear reasons for this. However, not all the recruited sample was involved in this study, as the saturation level was reached after collecting 24 interviews, as mentioned previously.

5.4.5 Data collection

The study took place in the Hadekat Al-Tefl kindergarten during September 2019. Data were collected using semi-structured interviews. The semi-structured interview questions are based on a previous study conducted by Li, Adab and Cheng (2015) ⁽³⁹⁶⁾ and (Davidson and Vidgen (2017) ⁽⁷³¹⁾). The structure and content of the interview can be found in (Appendix H). Previously, I received training at UCL with regard to conducting qualitative research (e.g. using thematic analysis and NVIVO software). In addition, at UQU, I received training on how to carry out qualitative research using semi-structure interviews. Prior to the actual data collection, a pilot exercise of conducting interviews with five colleagues was carried out.

The interviews were carried out by myself (female dietitian) with the help of a female research assistant. Participants were assured of confidentiality and encouraged to engage in the discussions. Participants were also provided with explicit reassurance that the level of childcare would not be affected by any

response. The interview started with an icebreaker session to build rapport. Mothers were asked a general question about their perception of childhood obesity and encouraged to speak freely. Then, open questions, active listening and follow-up questions were used to probe or expand upon their responses. The duration of the interviews ranged between 20-45 minutes. Of the 24 interviews collected, 20 mothers consented to audio-record the interview, while 4 did not. For these 4 participants, the principal researcher (myself) led the discussion, while the research assistant took notes and documented quotes manually. The interviews were not repeated, and the transcripts were not returned to the participants.

5.4.6 Ethical consideration and data protection

The protocol was reviewed and approved by both UCL research ethics committee and the research ethics committee at Umm-Al-Qura University, Medical Sciences College in the KSA. Details on the ethical approval and data protection were mentioned earlier in Section 5.3.6.

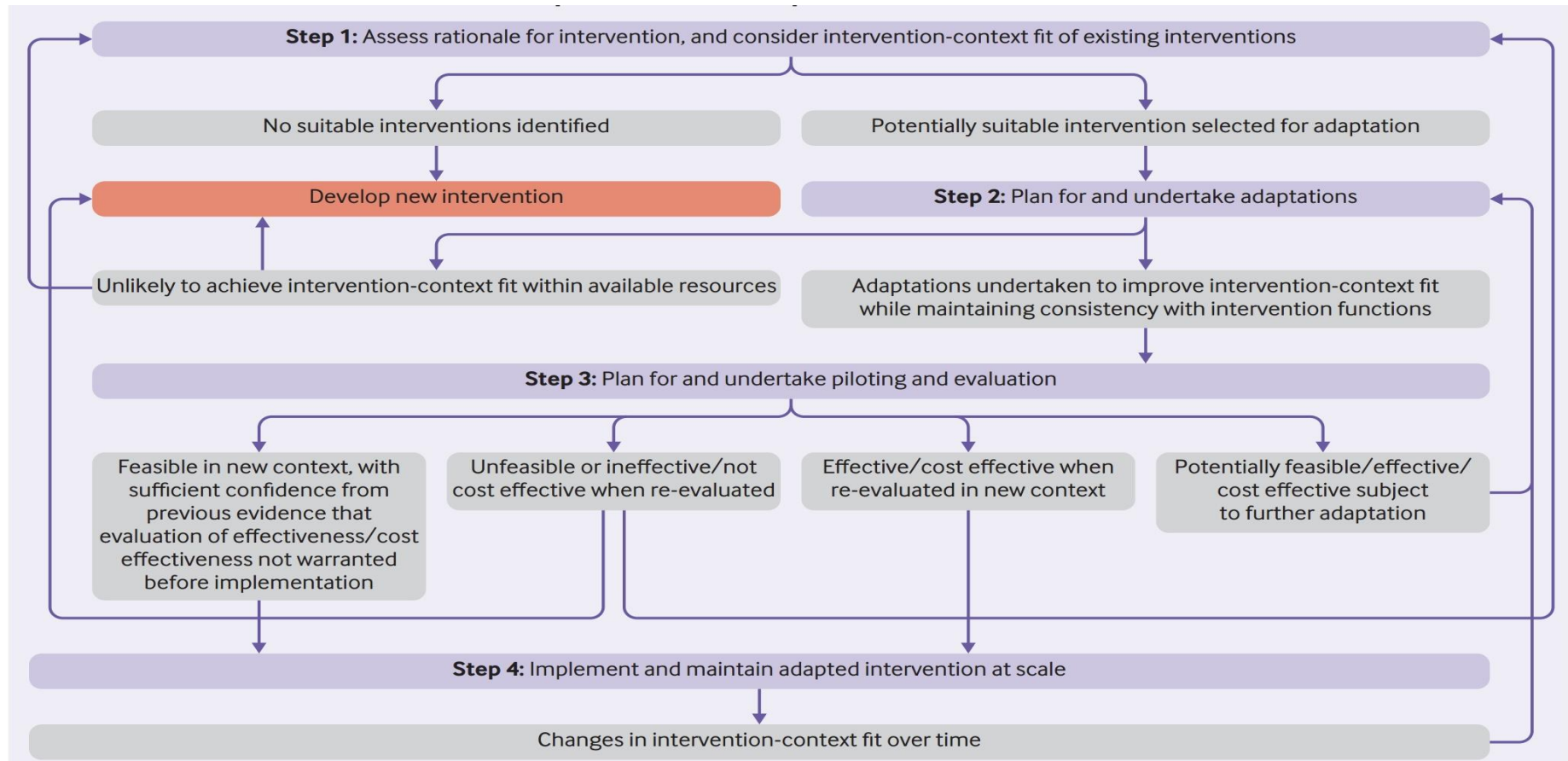
5.5 Study 3: Cultural adaptation of Trim Tots intervention

Customising an intervention to meet the requirements of a specific community's needs is one important factor that may increase the likelihood of success⁽⁷⁰³⁾. Therefore, the Trim Tots Intervention was adapted and tailored for the Saudi population. It is important to follow a quality control process to ensure correct deployment of the intervention adaptation process. Therefore, the adaptation process was guided by the framework of intervention adaptation described by Stirman et al. (2013)⁽⁷⁰⁹⁾. This was compatible with the ADAPT guidance, (2021)⁽⁷⁰⁸⁾ which provides a systematic method of carrying out intervention adaptation to a new context/population. A summary of such systematic adaptation guidance is illustrated in Figure 5-2. To ensure the modifications made were appropriate, this study aimed to carry out the adaptation in response to patient and public involvement (PPI), and were in line with the findings of the qualitative study and the risk factors research (Chapters 6 and 7). This led to the development of a co-created intervention.

Evidence suggests that co-creation is important and can increase acceptance of interventions (519; 732-734).

I adapted the Trim Tots intervention into two main stages. The first stage was to modify the intervention format and make it suitable for an alternative mode of delivery (i.e. via WhatsApp). The second stage of adaptation was to tailor the content of the intervention to make it more appropriate for the Saudi population. This included translation of the intervention content to the Arabic language and the inclusion of phrases commonly used by and well known to the Saudi population. Additionally, audio and visual materials relevant to Saudi culture were used. For instance, instead of using the food pyramid or my plate, the Saudi Palm was used to provide an illustration of a balanced diet. A further aspect of tailoring the content of the intervention aimed to address the specific root causes of obesity in the KSA. That is, the adaptation in this way was achieved using the feedback of two studies that were conducted as part of this PhD project [i.e. risk factors study (Chapter 6) and qualitative research (Chapter 7)]. The adaptation process was fully explained in Chapter 8.

Figure 5-2 ADAPT process model for adapting interventions to new contexts

Figure adapted from Moor et al. (2021) ⁽⁷³⁵⁾

5.6 Study 4: Feasibility study (pilot RCT)

5.6.1 Population and location

The population comprised Saudi preschool children attending the Hadekat Al-Tefl Kindergarten (in Makkah) and their mothers. This was the same cohort as found in the previous qualitative study (Section 5.5). However, the timeline for each study was different. That is, after completing the qualitative study, the randomisation of the pilot RCT took place. Using the same cohort in both studies may induce an effect on the intervention findings, since the participants may get more motivated for the change.

5.6.2 Sample size estimation

A sample size of 12 participants per treatment group is considered practical for most early-stage feasibility studies in a single centre to provide preliminary information, according to previous research ⁽⁷³⁶⁻⁷³⁸⁾. Therefore, 24 subjects were required for the pilot RCT (12 for the intervention and 12 for the control group). However, a 25% dropout was estimated based on a study conducted by a member of our research group, who conducted a similar study in the United Arab Emirates ⁽⁴²⁰⁾. Thus, an estimated 30 child-mother dyads were required for this feasibility study.

5.6.3 Study design

A randomised controlled trial design was chosen as it is considered the gold standard for research of this kind ⁽⁷³⁹⁾. The major advantage of RCTs is the straightforward investigation of cause-effect relationships with minimal bias ⁽⁷⁴⁰⁾. This design was also chosen because a pilot RCT would inform the possibility of conducting a larger RCT (e.g. feasibility of randomising mother infant dyads, compliance with intervention, blinding and projected sample size etc.).

5.6.4 Inclusion and exclusion criteria

The inclusion criteria were:

- Children aged 3-6 years, who would be attending the kindergarten for the 3 months' intervention duration.
- Children with overweight/obesity (based on BMI for age and sex according to WHO growth charts, as defined earlier in Section 5.3.5.7) or at increased risk of obesity (one or both parents overweight).
- Children with no pre-existing medical condition or severe allergies.
- Children and families of suitable social circumstances that allow regular session attendance
- Mothers with smartphones who are willing to engage via social media.

Children who did not meet the inclusion criteria were excluded.

5.6.5 Recruitment

As mentioned previously, the recruitment procedure was the same as that used for the qualitative study described in Section 5.4.4.

5.6.6 Randomisation

Randomisation was performed using a computer-generated sequence programme. A third party, who was not involved in the research, carried out the randomisation to minimise any possible bias. Participants were randomly allocated either to the intervention or control group. As an inducement to participate in the study, mothers were provided with air fryers. Mothers of children in the intervention group received the air fryers at the beginning of the study, while mothers of children in the control group received it after the end of the intervention and upon the data collection of the follow-up measurements.

5.6.7 Data collection

The intervention took place between October and December 2019. And is fully described in Chapter 8. Children engaged in healthy food colouring sessions, healthy snack preparation and physical activity (Figure 5-3 and 5-4). Follow-up measurements took place 6 months following the intervention completion (June 2020).

Information with regards to collected data is provided below.

5.6.7.1 Feasibility outcomes

Feasibility of the kindergarten as a venue for intervention delivery included assessment of equipment availability and appropriateness of available space for activities. Feasibility was also assessed by keeping attendance registers to provide an assessment of attrition and inform adherence and compliance. Additionally, the possibility of taking children's anthropometric measurements and completing questionnaires by mothers were taken into consideration. Safety of children and staff was evaluated. This included providing a record of any adverse events, such as those causing physical or psychological harm.

5.6.7.2 Other outcomes

Anthropometric measurements, dietary and physical activity factors were measured at baseline and the end of the intervention (3 months from baseline) using the same procedures mentioned in Section 5.3.5. However, the collection of anthropometric measurements at 6 months after intervention completion (9 months from baseline) was different. These measurements were reported by mothers; this is because the follow-up point coincided with the COVID-19 national lockdown in the KSA. Mothers were provided with guidelines for measuring and reporting height and weight in their children. Guidelines were extracted from the British Dietetic Association Paediatric Specialist Group advice on providing remote dietetic consultations during the COVID-19 and translated to Arabic ⁽⁷⁴¹⁾.

5.6.8 Ethical consideration and data protection

The protocol was reviewed and approved by the research ethics committee at UCL and the Umm-Al-Qura University, Medical Sciences College in the KSA. Details on the ethical approval and data protection were mentioned earlier in Section 5.3.6.

Figure 5-3 Preschool children participating in the intervention (colouring session)



Photos are used with the consent of mothers

Figure 5-4 Preschool children participating in the intervention (Healthy Snacks sessions)



Photos are used with the consent of mothers

5.7 Statistical Methods

This PhD project used a mixed-methods approach. IBM SPSS v24 was used to analyse the quantitative data, while the NVIVO11 programme was used for the qualitative data analysis. Full details of the statistical techniques used are given for each of the 4 studies

5.7.1 Study 1: Risk factors study

The primary analysis plan for the risk factors study was to test the hypotheses of the risk factors study, as indicated in Chapter 4. This included examining the association between less healthy diets (e.g. fast food, high protein diet and low vegetables intake) and sedentary lifestyle (e.g. long duration of screen time) with the risk of developing overweight and obesity in Saudi preschool children. Further analysis will be applied to test any associations between child eating behaviours, as well as parental feeding styles with the risk of preschool obesity in the KSA. Also, the influence of infant feeding practices will be examined. A summary of the variables collected via the study and the statistical methods used can be found in Table 5-1, and full explanation of analyses performed can be found below.

5.7.1.1 Descriptive Statistics

The normality of data was checked using scatter plots and histograms. Moreover, a narrow range of skewness and kurtosis values lying between -1 to 1 was used to check normality of data⁽⁷⁴²⁾. Not normally distributed variables including duration of exclusive breastfeeding and duration of exclusive formula feeding were log-transformed ($\log_e$). Continuous data were presented as mean (SD), while categorical data were presented as frequency (%). Data were compared according to sex. Comparison between groups was performed using independent t-test for continuous variables. Chi-squared was used to compare categorical variables. Level of significance was set at (<0.05).

5.7.1.2 Associations

According to the hypotheses stated in Chapter 4, several risk factors could be associated with the risk of obesity in Saudi preschool children. To test such associations, it was planned to use both linear and logistic regression analyses, as indicated in this section.

Linear regression analysis was used to examine associations between risk factors as continuous variables and child BMI z-score. This method provided an estimate of the variation in BMI z-score that may be explained by known risk factors. Firstly, univariate analysis was used to examine associations between each risk factor and child BMI z-score. Then, multiple linear regression models were developed, in which confounding factors known to influence the development of overweight/obesity were added sequentially for adjustment. Confounding variables included in the model were selected in accordance with the current literature and existing knowledge of confounding factors that influence the risk of developing overweight/obesity. These confounders included child age, sex, maternal age and BMI, parental education and social class. Thus, each risk factor was tested after controlling for these confounding factors. A beta coefficient with 95% Confidence Intervals (CI) was calculated to identify variables associated with BMI z-score.

Logistic regression analysis was used to examine associations between risk factors and child weight status which was dichotomised into two categories: not overweight/obese vs overweight/obese. Each risk factor was first examined using univariate logistic regression. Then, multiple logistic regression models were developed, in which confounding factors were entered sequentially for adjustment. An Odds Ratio (OR) with 95% Confidence Intervals (CI) was calculated to estimate the influence of potential risk factors on the risk of developing overweight/obesity.

5.7.2 Study 2: Qualitative study

NVIVO vr11 (QSR International Pty Ltd., Burlington, MA) was used to analyse the quantitative data. Thematic analysis was used as the main analytic option⁽⁷⁴³⁾. This process went through 6 main stages. First, I familiarised myself with the data via verbatim transcribing of the interviews and re-reading through the data set. Second, I generated initial codes by making notes of initial interesting features of the data and collating those relevant to each code. Third, I developed the main themes by gathering relevant codes into themes. This included clustering the emerging themes into categories and subcategories. Fourth, I revised themes and checked for coherence. Fifth, I made refinement to the final names and definitions of the extracted themes. Finally, I produced the report, providing quotes that were selected on the basis that they best supported each theme and subtheme.

5.7.3 Study 4: Pilot RCT

As mentioned previously, the primary aim of this pilot RCT is to test the feasibility of conducting a lifestyle intervention in the KSA. This was achieved by evaluating the compliance to the intervention and considering the feedback of the participants. The secondary aim is to test the effect of the intervention. The primary outcome for examining the intervention effect is BMI z-score. The primary analysis for the intervention effect is to measure the absolute difference in child BMI z-score between the randomised groups. The secondary analysis is to measure the change in BMI z-score (from baseline to the end of the intervention) between the randomised groups. Further analyses would be applied to test any potential improvement in obesity related factors (e.g. dietary intake). A summary of the variables collected via the study and the statistical methods used can be found in Table 5-2, and all statistical methods used for analysis are explained in detail below.

5.7.3.1 Descriptive Analysis

Data were normally distributed. Testing the normality of data and presenting such descriptive analysis were performed using the same methods explained

in Section 5.7.1.1. Comparison between intervention and control group was performed using independent t-test for continuous variables. Chi-squared was used to compare categorical variables. Level of significance was set at (<0.05).

5.7.3.2 Evaluation

To evaluate the feasibility and acceptability of conducting a lifestyle intervention in the KSA, response rate and attendance rate were calculated. In addition, the mothers' feedback was collected and analysed using thematic analysis with the same methods explained earlier in Section 5.7.2.

5.7.3.3 Intervention effect

Primary analysis

The primary analysis was to measure the difference in BMI z-score between randomised groups after the intervention, using independent student's t-test. Then ANCOVA was used to adjust for baseline measurements in BMI, age and sex.

Secondary analysis

The secondary analysis was applied only to anthropometric measurements. It was used to compare the change in BMI z-score (from baseline to the end of the intervention) between randomised groups. Changes in outcomes (pre- and post-intervention) were compared between randomised groups using independent student's t-test. Then, ANCOVA was again used to adjust for baseline BMI z-score values, age and sex.

Within-subject change was a further analysis that compared the change in outcomes from baseline to the end of the intervention (for all outcomes) in parallel groups separately (i.e. before and after). This was performed using paired t-test. The level of significance was taken as P-value <0.05 .

Table 5-1 A summary of the variables collected and statistical methods used in the Risk Factors Study

Data	Variables	Statistical methods
Socio-demographic	-Child Age, years Sex, n (%) Ethnicity, n (%) Birth weight kg/m ² Weight, kg/m ² Height, cm Waist circumference, cm BMI z-score, kg/m ² Weight status, n (%) -Mother Age, years Weight height, kg/m ² Waist circumference, cm BMI, kg/m ² Education; with university degree, n (%) Occupation, n (%) Domestic helper, n (%) Family member helper, n (%) -Father Education; with university degree, n (%) Social class; manual , n (%)	Descriptive statistics Continuous Data -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Categorical Data -Frequency and percentage Associations Continues data -Linear Regression Categorical data -Logistic regression

Table 5-1 A summary of the variables collected and statistical methods used in the Risk Factors (continued)

Data	Variables	Statistical methods
Infant feeding	Initiation of breast feeding	Descriptive statistics
	Duration of exclusive breastfeeding EBF, months	Continuous Data
	EBF $\geq$ 1 month, n (%)	-Normally distributed data (Mean and SD)
	EBF 2-3 months, n (%)	-Log-transformation will be used for non-normally distributed data
	EBF $\geq$ 4 months, n (%)	Categorical Data
	EBF $\geq$ 6 months, n (%)	-Frequency and percentage
	Duration of mixed feeding), months	
	Any BF > 4 months, n (%)	Associations
	Any BF > 6 months, n (%)	Continues data
	Age of formula introduction, months	-Linear Regression
	Duration of exclusive formula feeding EFF, months	Categorical data
	EFF $\geq$ 4 months, n (%)	-Logistic regression
	EFF $\geq$ 6 months, n (%)	
	Age of complementary feeding introduction, months	
	CF < 4 months, n (%)	
	CF < 6 months, n (%)	
	Using Pacifier, n (%)	

Table 5-1 A summary of the variables collected and statistical methods used in the Risk Factors (continued)

Data	Variables	Statistical methods
Parental feeding style	Instrumental feeding, score (continuous scale) Control, score (continuous scale) Emotional eating, score (continuous scale) Encouragement to eat, score (continuous scale)	Descriptive statistics Continuous Data -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Associations Continues data -Linear Regression
Child eating behaviour	Food responsiveness, score (continuous scale) Food fussiness, score (continuous scale) Emotional over eating , score (continuous scale) Emotional under eating, score (continuous scale) Slowness in eating, score (continuous scale) Satiety responsiveness, score (continuous scale) Enjoyment of food, score (continuous scale) Desire to drink, score (continuous scale)	Descriptive statistics Continuous Data -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Associations Continues data -Linear Regression

Table 5-1 A summary of the variables collected and statistical methods used in the Risk Factors (continued)

Data	Variables	Statistical methods
Food preferences	Fruit, score (continuous scale) Vegetables, score (continuous scale) Meat, score (continuous scale) Dairy, score (continuous scale) Starch, score (continuous scale) Snacks, score (continuous scale) Fast food, score (continuous scale)	Descriptive statistics Continuous Data -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Associations Continues data -Linear Regression
Home environment, Sedentary behaviour, screen time and physical activity	Inside playroom, n (%) Outside playground/yard, n (%) Screen time > 1 hr/day, n (%) Physical activity > 1 hrs/day, n (%)	Descriptive statistics Categorical Data -Frequency and percentage Associations Categorical data -Logistic regression

Table 5-2 A summary of the variables collected and statistical methods used in the pilot RCT

Data	Variables	Statistical methods
Socio-demographic	-Child Age, years Sex, n (%) Ethnicity, n (%) Birth weight kg/m2 Weight, kg/m2 Height, cm Waist circumference, cm BMI z-score, kg/m2 Weight status, cm -Mother Age, years Weight height, kg/m2 Waist circumference, cm BMI, kg/m2 Education; with university degree, n (%) Occupation, n (%) Domestic helper, n (%) Family member helper, n (%) -Father Education; with university degree, n (%) Social class; manual , n (%)	Descriptive statistics Continuous Data -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Categorical Data -Frequency and percentage Difference/Change between groups -Independent T-test, -ANCOVA was used to adjust for baseline measurement, age and sex <u>Within subject change</u> -Paired T-test

Table 5-2 A summary of the variables collected and statistical methods used in the RCT (continued)

Data	Variables	Statistical methods
Parental feeding style	Instrumental feeding, score (continuous scale) Control, score (continuous scale) Emotional eating, score (continuous scale) Encouragement to eat, score (continuous scale)	Descriptive statistics -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Difference between groups -Independent T-test -ANCOVA was used to adjust for baseline measurement, age and sex <u>Within subject change</u> -Paired T-test
Child eating behaviour	Food responsiveness, score (continuous scale) Food fussiness, score (continuous scale) Emotional over eating , score (continuous scale) Emotional under eating, score (continuous scale) Slowness in eating, score (continuous scale) Satiety responsiveness, score (continuous scale) Enjoyment of food, score (continuous scale) Desire to drink, score (continuous scale)	Descriptive statistics -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Difference between groups -Independent T-test -ANCOVA was used to adjust for baseline measurement, age and sex <u>Within subject change</u> -Paired T-test

Table 5-2 A summary of the variables collected and statistical methods used in the RCT (continued)

Data	Variables	Statistical methods
Food preferences	Fruit, score (continuous scale) Vegetables, score (continuous scale) Meat, score (continuous scale) Dairy, score (continuous scale) Starch, score (continuous scale) Snacks, score (continuous scale) Fast food, score (continuous scale)	Descriptive statistics -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Difference between groups -Independent T-test, -ANCOVA was used to adjust for baseline measurement, age and sex <u>Within subject change</u> -Paired T-test
Home environment and lifestyle factors	Inside playroom, n (%) Outside playground/yard, n (%) Screen time > 1 hr/day, n (%) Physical activity > 1 hrs/day, n (%)	Descriptive statistics Categorical Data Frequency and percentage Difference between groups -Independent T-test -ANCOVA was used to adjust for baseline measurement, age and sex

Table 5-2 A summary of the variables collected and statistical methods used in the RCT (continued)

Data	Variables	Statistical methods
Assessment of intervention feasibility and acceptability	Response rate, n (%) Attendance, sessions number Mothers' feedback, comments	Descriptive statistics Continuous Data -Normally distributed data (Mean and SD) -Log-transformation will be used for non-normally distributed data Categorical Variables -Frequency and percentage Qualitative data Thematic analysis

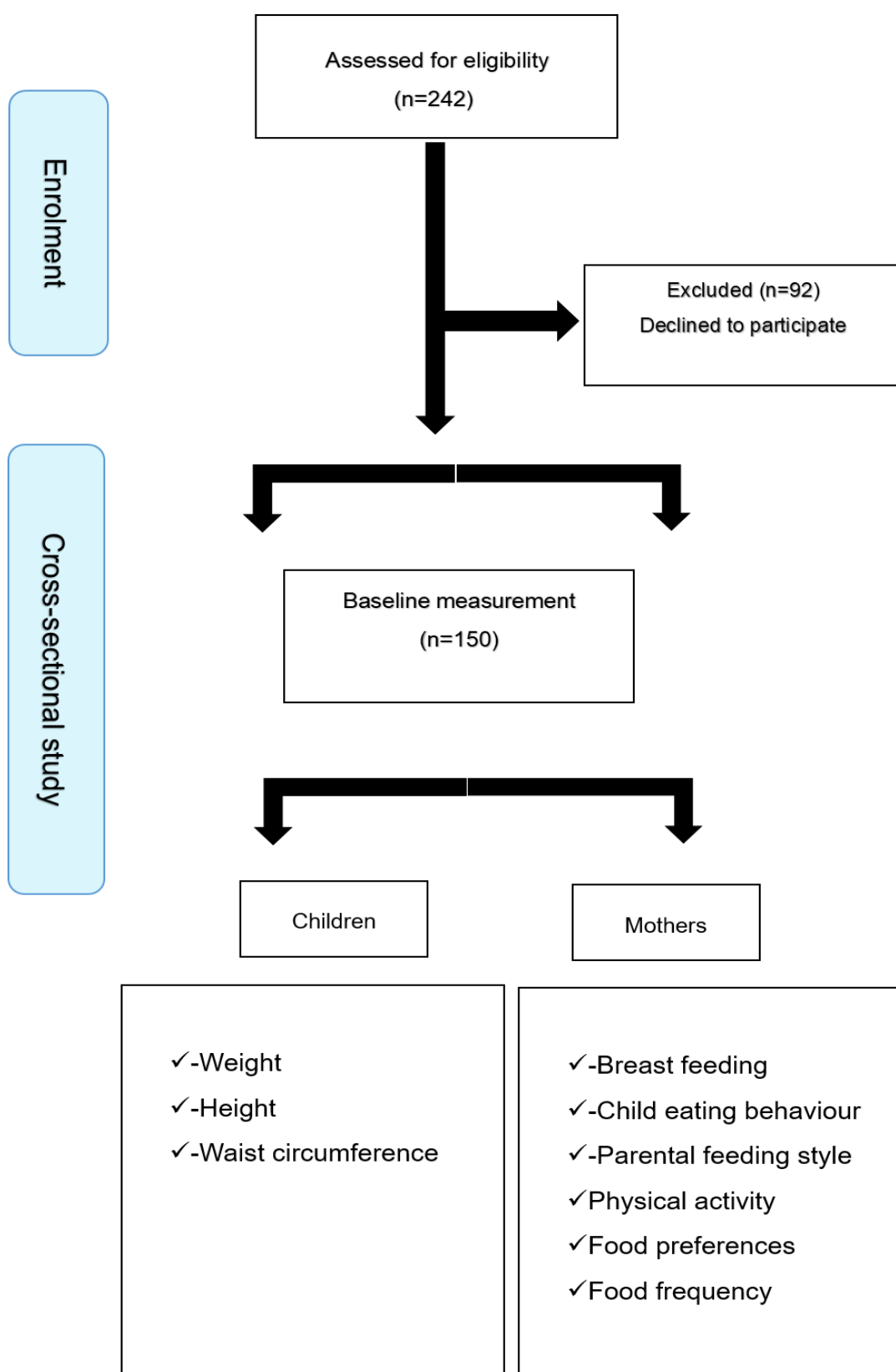
6. Chapter 6: Study 1 Results: Risk factors for obesity in preschool children in the KSA.

6.1 Introduction

Several factors are widely accepted as determinants of childhood overweight/obesity as explained in Chapter 1. However, as indicated by Chapter 2, little is known about the determinants of overweight and obesity in the KSA, particularly in preschool children. Hence, this study investigated the risk factors of overweight and obesity in Saudi preschool children residing in the city of Makkah. Factors investigated include infant feeding practices, child eating behaviours, parental feeding styles, child lifestyle behaviours (sedentary behaviours and physical activity levels), child food preferences and dietary intake.

6.2 Results

The methods and outcome measures have been described in Chapter 5. The flow of participants through the study is illustrated in Figure 6-1. 242 Saudi mothers were contacted between December 2018 and September 2019, and invited to participate with their children. Of these, 150 mothers consented to participate and complete data were available for their Saudi preschool children. This included information on the 76 boys and 74 girls, which is summarised in Tables 6-1 to 6-8. The analysis of risk factors for childhood overweight/obesity are presented in Tables 6-9 to 6-18.

Figure 6-1 Flow chart of risk factors study

6.3 Baseline socio-demographic and anthropometric characteristics of study participants

Socio-demographic and anthropometric characteristics of the study population are presented in Tables 6-1 and 6-2, and compared to national data where possible. The mean (SD) age of the participating children was 4.5 (0.9) years, 50.7% were males and 49.3% females. (Table 6-2). Mothers and fathers with a university degree represented 77.3% and 78.7% of the studied sample respectively (Table 6-1). This is higher than the national proportion of Saudi Adults with a university degree, which was reported by the Saudi Arabian General Authority for Statistics in 2017. This data showed that 28.1% of males and 25.5% of females were with a university degree ⁽⁷⁴⁴⁾. However, the data of the present study is comparable to a more recent study conducted by Mesawa et al (2020), which reported that 62.6% of males and 54% of females were with a university degree ⁽⁴³¹⁾ (Table 6-1).

In the present study, most fathers were of non-manual occupations and only 5.3% worked in manual jobs (Table 6-1). The comparison to national data was hampered by the lack of precise information provided by the general authority for statistics in the KSA. However, a study conducted by Darwish et al in 2014, reported that fathers with non-manual occupations represented 90% of their sample size which is comparable to our findings ⁽⁴⁴⁹⁾. Employment rate in the participated mothers was 40.6%. This is slightly higher than the national rate of women employment in the KSA which accounts for 33.6%, according for the general authority for statistics ⁽⁷⁴⁵⁾. However, Darwish et al study reported that employment rate in mothers of Saudi preschool children was 43.7% ⁽⁴⁴⁹⁾ which is comparable to the present study finding. The current study found that 54.0% of children received informal care (e.g. domestic helper or family member), (Table 6-1). However, it was not possible to compare these findings with a representative data due to the paucity of resources, as this is area was not yet fully covered.

The mean (SD) BMI z-score of children participating in the present study was 0.1 (1.3). Children with overweight and obesity represented 12.7% and 7.3%

respectively (Table 6-2). This is higher than the prevalence of overweight (8.7%) and obesity (2.5%) in Saudi preschool children that was reported by the latest national study in the region ⁽⁴¹⁰⁾. However, such national data was old (since 2010) and was not updated yet. Nonetheless, the present study findings were comparable to a more recent study conducted by El-Gamal et al. (2020) ⁽⁴¹⁷⁾. It reported that Saudi preschool children with overweight and obesity represented 11% and 8.6% of their studied sample, respectively (Table 6-2). Mean (SD) BMI of mothers was 26.7 (3.7) kg/m² and of these, 68.2% were with overweight or obesity (Table 6-1). This is comparable to the national prevalence of overweight and obesity in Saudi women (65.7%), based on the data from the World Health Survey for Saudi Arabia (2019) ⁽⁷⁴⁶⁾.

6.4 Home environment and lifestyle characteristics of the studied sample.

Characteristics of the home environment and children's physical activity behaviours (sedentary behaviours and physical activity level) are presented in Table 6-3. In our sample, 87.3% of Saudi families had an inside play area; however, only 58% lived in a neighbourhood with a suitable outside play area or yard. The main mode of transportation in Saudi Arabia is via cars and this was used by 100% of the study participants. However, in addition to using cars, 46% of the families also used walking for transportation. The study's findings also showed that 46% of the children spent more than an hour/day watching TV and 52% actively played for more than one hour/day.

6.5 Infant feeding

Infant feeding practices are presented in Tables 6-4 and 6-5. It is worth mentioning that from my interaction with mothers during the process of completing the questionnaires, I noticed that there are many practices for infant feeding in the KSA. For instance, many mothers provided infants with water and traditional herbal infusions such as diluted anise and diluted date infusion. Other mothers, provided formula, non-dairy milk alternative or organic milk. However, this study focused on analysing the data concerning exclusive

breast feeding (according to the WHO definition) and any breastfeeding (mixed feeding).

As shown in Table 6-4, 88% of Saudi mothers initiated breastfeeding while 12% did not breastfeed at all. Of breastfeeding mothers, only 6% exclusively breastfed their infants for 6 months (Table 6-4). As shown in Table 6-5, mixed feeding was common within the study population, with 64% of mothers reporting mixed feeding for at least 6 months. The mean (SD) age for the introduction of infant formula was 1.8 (1.9) months. Complementary feeding was introduced at a mean (SD) age of 5.1 (1.4) months.

6.6 Parental feeding style and child eating behaviour

The means (SD) of parental feeding styles and child eating behaviours are illustrated in Table 6-6. Of the four parental feeding style categories investigated, encouragement to eat scored the highest [mean (SD) score: 4.2 (0.5)], whereas emotional feeding scored the lowest [mean (SD) score: 2.1 (0.8)]. Of the eight child eating behaviours investigated, the desire to drink trait scored the highest [mean (SD) score: 3.5 (0.2)] and it was significantly higher in boys compared to girls (mean (SD) 3.9 (0.1) vs 3.2 (0.2), $p=0.01$). Conversely, emotional overeating scored the lowest, [mean (SD) score: 1.7 (0.6)].

6.7 Food preferences

Children's preference scores for different food groups are displayed in Table 6-7. The highest value on the numeric scale used to measure food preference was five. Snack preferences scored the highest [mean (SD) score: 4.0 (0.5)], while vegetable preferences scored the lowest [mean (SD) score: 2.7 (0.6)]. Additionally, the average number of meals taken outside the house was 2.5 (0.6) meals/week.

6.8 Food frequency intake and healthy plate variety score (HPVS)

Table 6-8 presents the average daily servings of the five main food groups, each food group score and the total HPVS. Ideally, each group score should be one and the HPVS should be five. The meat food group scored the highest [mean (SD) score: 0.9 (0.2)], while the vegetable group scored the lowest [mean (SD) score: 0.5 (0.2)]. The average HPVS was 3.2 (0.6).

6.9 Associations between sociodemographic and anthropometric characteristics and risk of childhood overweight/obesity.

Associations between sociodemographic and anthropometric characteristics with the risk of childhood overweight/obesity (BMI z-score) are presented in Tables 6-9 and 6-15.

Linear regression analysis

Maternal BMI was associated with child BMI z-score in the unadjusted model. The child BMI z-score was 0.1 point higher (95% CI: 0.002 to 0.1; $p=0.04$) for each additional unit of the mother's BMI. However, this association was attenuated and only borderline significant after adjustment for confounding factors known to influence obesity risk (age, sex, mother's age and educational level, father's educational level and social class), ($p=0.05$). Additionally, the child BMI z-score was found to be influenced by the mother's working status. In the unadjusted model, children of working mothers had a 0.4 higher BMI z-score (95% CI: 0.02 to 0.8; $p=0.04$) compared to children whose mothers stayed at home. However, this association was no longer significant after adjusting for possible confounding factors ($p=0.06$), (Table 6-9).

Receiving informal care (i.e. being looked after by either a domestic helper or a family member) was associated with a child's BMI z-score in both the unadjusted and adjusted models (Table 9-6). Children who received informal care had a higher BMI z-score compared to children who were looked after by their parents [mean difference (MD) in BM z-score: 0.6 (95% CI: 0.2 to 1.1;

$p=0.003$)] according to the adjusted model (Table 6-9). However, there was no association with child BMI z-score according to sex, birth weight, maternal age, or parental education level in the linear regression models (Table 6-9).

Logistic regression analysis

The influence of such informal care provided either by domestic or family member helpers was supported by logistic regression analyses. The adjusted model of the analysis found that the probability of a child developing overweight or obesity was 3.8-fold higher (95% CI: 1.3 to 11.0; $p=0.01$) when children received informal care compared to parental care (Table 6-15).

6.10 Associations between home environment and lifestyle factors with risk of childhood overweight/obesity

Associations between the home environment, sedentary behaviour, physical activity and risk of obesity (based on BMI z) in children are presented in Tables 6-10 and 6-16.

Linear regression analysis

The presence of a suitable outside play-area or yard was protective against overweight/obesity in both the unadjusted and adjusted models using linear regression analysis. After adjustment for confounding factors, BMI z-score was 0.5 points lower (95% CI: -0.9 to -0.1; $p=0.01$) for children who lived in a neighbourhood with a suitable outside play area or yard compared to children who did not have this facility (Table 6-10). The influence of screen time on child BMI z-score was clear in both the unadjusted and adjusted models. That is, after adjustment for confounding factors, the BMI z-score was higher by 0.2 points (95% CI: 0.2 to 1.1; $p=0.003$) for children who spent more than one hour/day watching TV, compared to their counterparts who spent less than one hour/day (Table 6-10).

Logistic regression analysis

Both the unadjusted and adjusted models of logistic regression analysis confirmed the protective effect of an outside play area or yard against childhood overweight/obesity. The probability of developing childhood overweight/obesity was 80% lower (OR=0.2, 95% CI: 0.1 to 0.5; $p=0.002$) in a neighbourhood with a suitable outside play-area/yard after adjusting for confounding factors. In addition, after adjusting for possible confounding factors, the probability of overweight/obesity was higher by 2.9-fold (95% CI: 1.1 to 7.7; $p=0.02$) when children spend more than one hour/day on screens compared to less than one hour/day (Table 6-16).

6.11 Associations between infant feeding practices with the risk of childhood overweight/obesity

Associations between infant feeding practices and the risk of obesity are summarised in Tables 6-11, 6-17 and 6-18.

Linear regression analysis

A longer duration of exclusive breastfeeding was found to be significantly protective against childhood obesity in both the unadjusted and adjusted models. In the fully adjusted model, child BMI z-score was lower by 0.1 points (95% CI: -0.2 to -0.02; $p=0.01$) for each additional month of exclusive breastfeeding. Mixed feeding also showed this association. The child BMI z-score was lower by 0.03 points (95% CI: -0.1 to -0.003; $p=0.01$) for each additional month of any breastfeeding, as shown in the fully adjusted model (Table 6-11).

Conversely, other factors were adversely associated with increased risk of childhood overweight/obesity, such as never receiving exclusive breastfeeding and pacifier usage. Both the unadjusted and adjusted models supported such associations. As shown in the fully adjusted model, children who were never exclusively breastfed had a higher BMI z-score by 0.4 points (95% CI: 0.04 to

0.9; $p=0.03$) compared to their counterparts, who received exclusive breastfeeding for any period. Additionally, using a pacifier was a significant predictive factor for childhood obesity. In the fully adjusted model, the BMI z-score was 0.8 points higher (95% CI: 0.4 to 1.2; $p=0.0001$) in children given a pacifier compared to those who were not given a pacifier (Table 6-11).

Logistic regression analysis

The risk of obesity was lowered in children who received any sort of breastfeeding in the first 4 months compared with those who were not breastfed. This was seen in unadjusted and adjusted models and for breastfeeding in the first 4 and 6 months. In the fully adjusted model, the probability of obesity was lowered by 70% (OR=0.3, 95% CI: 0.1 to 0.7; $p=0.01$) when children received any breastfeeding for at least 4 months in comparison to those who were not breastfed. In the fully adjusted model, children who received any breastfeeding for at least 6 months had a 90% lower risk of developing overweight/obesity compared with children that were not breastfed (OR=0.1, 95% CI: 0.03 to 0.2; $p=0.0001$) (Table 6-17). The risk of obesity was 2.4 times greater in children who were never exclusively breastfed compared to children who received exclusive breastfeeding for any period (OR=2.4, 95% CI: 1.4 to 9.7; $p=0.01$) in the fully adjusted model (Table 6-17).

Exclusive formula feeding was associated with higher risk of childhood overweight/obesity. Unadjusted logistic regression found that the odds of developing overweight/obesity in children who received exclusive formula feeding for at least four months was 4.2 times greater than their counterparts, who did not receive exclusive formula feeding for that duration (OR=4.2, 95% CI: 1.4 to 12.1; $p=0.01$). However, the association became insignificant after controlling for potential confounding factors ($p=0.2$), (Table 6-18).

Earlier introduction of complementary feeding was a significant determinant of childhood overweight/obesity in both the unadjusted and adjusted models. In the fully adjusted model, the risk of developing overweight/obesity in children who received complementary feeding before 6 months was 2.9 times higher

than their counterparts who received complementary feeding after 6 months compared to before 6 months (OR=2.9, 95% CI: 1.6 to 10.1; $p=0.006$). Lastly, pacifier usage was associated with a higher risk of developing overweight/obesity in children. According to the fully adjusted model, the odds of developing overweight/obesity were 3.1-fold greater for children who were given pacifiers when compared to those who were not (OR=3.1, 95% CI: 1.1 to 8.0; $p=0.02$), (Table 6-18).

6.12 Associations between parental feeding style and child eating behaviours with the risk of childhood overweight/obesity

Associations between parental feeding styles and child eating behaviours with risk of obesity (BMI z-score) are shown in Table 6-12. Of the four different parental feeding styles evaluated, encouragement to eat was negatively associated with the child BMI z-score in both the adjusted and unadjusted models of linear regression analysis. The fully adjusted model indicated that BMI z-score was lowered by 0.4 points (95% CI; -0.8 to -0.02; $p=0.04$) for each additional score on the encouragement to eat scale. Conversely, instrumental feeding showed a trend towards a positive association with the child BMI z-score in the unadjusted model. Child BMI z-score was 0.2 points higher (95% CI; -0.01 to 0.4; $p=0.05$) for each additional score on the instrumental feeding scale. However, this association was attenuated and was no longer significant after adjusting for potential confounding factors ($p=0.1$).

Concerning child eating behaviours, four of the eight different eating behaviours were positively associated with child BMI z-score in both the unadjusted and adjusted models. These included food responsiveness, emotional overeating, enjoyment of food and desire to drink. The analysis of the fully adjusted models found that BMI z-score was higher by 0.3 points (95% CI; 0.1 to 0.6; $p=0.002$) for each additional score on the food responsiveness scale. BMI z-score was higher by 0.6 (95% CI; 0.2 to 0.9; $p=0.001$) for each additional score on the emotional overeating scale. BMI z-score was higher by 0.5 points (95% CI; 0.3 to 0.8; $p=0.0001$) for each additional score on the enjoyment of food scale. BMI z-score was higher by 0.2 (95% CI; 0.03 to 0.3;

$p=0.01$) for each additional score on the desire to drink scales. In contrast, satiety responsiveness was negatively associated with child BMI z-score, in which it was lower by 0.4 points (95% CI; -0.7 to -0.1; $p=0.005$) for each additional score on the satiety responsiveness scale, as shown in the fully adjusted model.

6.13 Associations between food preferences with the risk of childhood overweight/obesity

Associations between food preferences and child BMI z-score were examined using linear regression analysis; the results for this are set out in Table 6-13. Of the different food groups, meat, snacks and fast-food preference scores were positively associated with childhood overweight/obesity in both the unadjusted and adjusted models. According to the fully adjusted models, the child BMI z-score was higher by 0.3 points (95% CI; 0.03 to 0.7; $p=0.03$) for each additional score on the meat preference scale. BMI z-score was higher by 0.5 points (95% CI; 0.1 to 0.9; $p=0.01$) for each additional score on the snacks preference scale. The BMI z-score was found to be higher by 0.4 points (95% CI; 0.04 to 0.7; $p=0.02$) for each additional score on the fast-food preference scale. Additionally, the average food intake from outside the home was associated with childhood overweight/obesity in the unadjusted model. The child BMI z-score was higher by 0.3 points for each meal from outside (95% CI; 0.01 to 0.6; $p=0.04$). However, after adjustment for confounding factors, this association attenuated ($p=0.06$).

6.14 Associations between food frequency intake with the risk of childhood overweight/obesity

The association between the daily servings of each food group with child BMI z-score was examined using linear regression analysis and the results are presented in Table 6-14. Of the main food groups, more frequent servings of meat were positively associated with overweight/obesity. In the unadjusted model, the child BMI z-score was higher by 0.3 points for each extra daily

serving of meat (95% CI; 0.01 to 0.7; $p=0.04$). However, after adjustment for confounding factors, this association was attenuated ($p=0.06$).

Additionally, carbohydrate intake showed a trend toward a positive association with childhood overweight/obesity ($p=0.05$) in the unadjusted model. The child BMI z-score was higher by 0.2 points (95% CI; 0.0 to 0.4; $p=0.05$) for each extra daily serving of carbohydrates. This borderline association disappeared after controlling for confounding factors ($p=0.08$). Moreover, a higher intake of vegetables was protective against childhood overweight/obesity. That is, the analysis found a significant negative association between vegetable intake and the development of childhood overweight/obesity in both unadjusted and adjusted models. The child BMI z-score was lower by 0.3 points (95% CI; -0.6 to -0.04; $p=0.02$) in association with each extra daily serving of vegetables, in the fully adjusted model.

6.15 Summary of findings

In summary, this study identified several risk factors for overweight/obesity in the participating Saudi preschool children. Higher maternal BMI was associated with higher child BMI z-score. However, maternal age, parental education level and social class were not associated with overweight/obesity risk. Screen time was significantly associated with the likelihood of developing overweight/obesity, whereas physical activity did not appear to influence overweight/obesity risk. Infant feeding practices were strongly associated with childhood overweight/obesity. In particular, children who were never exclusively breastfed, pacifier usage and early introduction of complementary feeding were all associated with the risk of later obesity. Conversely, there was a strong protective influence of breastfeeding for 6 months and beyond on the later risk of obesity in early childhood.

Children who received informal care were also at a higher risk of developing childhood overweight/obesity. Of child eating behaviours, food approach behaviours were associated with higher BMI z-score in both adjusted and unadjusted models. A higher preference for meat, snacks and fast foods was

associated with a higher BMI z-score in children. Higher daily intake of meat servings was a significant determinant of childhood overweight/obesity. Conversely, higher daily intake of vegetable servings was protective against childhood overweight/obesity. The identification of such factors could be helpful in term of designing the appropriate obesity preventative interventions.

Table 6-1 Socio-demographic and anthropometric characteristics of study participants (parents)

	All		Girls		Boys		p ¹	Comparison data	
	n=150		n=74		n=76			National/published	
Mother									
Age, years	35.3	(10.1)	33.2	(10.4)	37.4	(9.4)	0.1	32.4 ^a	31.2 ^b
Education; with a degree, %(n)	77.3	(116.0)	77.0	(57.0)	77.6	(59.0)	0.9	25.5 ^c	54.0 ^d
Working, %(n)	40.6	(61.0)	28.4	(21.0)	52.6	(40.0)	0.3	33.6 ^e	43.7 ^b
Informal care, %(n)	54.0	(81.0)	45.9	(34.0)	61.8	(47.0)	0.5	-	-
Household structure, extended, %(n)	32.7	(49.0)	31.1	(23.0)	34.2	(26.0)	0.7	-	33.0 ^f
Anthropometry									
BMI, kg/m ²	26.7	(3.7)	26.8	(3.6)	26.5	(3.8)	0.1	28.6 ^g	28.2 ^h
Waist circumference, cm	79.1	(15.8)	81.1	(15.6)	77.3	(15.8)	0.6	75.0 ⁱ	80.2 ^j
Weight status; overweight/obese, %(n)	68.2	(101.0)	67.6	(50.0)	67.1	(51.0)	0.9	65.7 ^k	63.5 ^j
Father									
Education; with a degree, %(n)	78.7	(118.0)	81.1	(60.0)	76.3	(58.0)	0.4	28.1 ^c	62.2 ^d
Social Class; manual, %(n)	5.3	(8.0)	5.4	(4.0)	5.2	(4.0)	0.9	-	90.0 ^b

All data are mean (SD) unless indicated.

¹ Comparison between groups using independent t-test for continuous normally distributed variables and Chi-squared for categorical variables.

^a Data from Saudi Arabia population statistics (2022) ⁽⁷⁴⁷⁾, ^b Data from Darwish et al. (2014) ⁽⁴⁴⁹⁾, ^c Data from Saudi Arabian General Authority for Statistics (2017) ⁽⁷⁴⁴⁾, ^d Data from Mesawa et al. (2020) ⁽⁴³¹⁾, ^e Data from General Authority for Statistics (2022) ⁽⁷⁴⁵⁾, ^f Data from Al-Oqaily (1996) (748), ^g Data from Al-Nozha et al. 2005 (749), ^h Data from Al-Hamad et al. (2021) ⁽⁴²⁴⁾, ⁱ Data from World Health Survey Saudi Arabia (2019) ⁽⁷⁴⁶⁾, ^j Data from Al-Harbi and Robert (2017) ⁽⁷⁵⁰⁾, ^k Data from Al-Raddadi et al. (2019) ⁽⁷⁵¹⁾.

Table 6-2 Socio-demographic and anthropometric characteristics of study participants at age 3 to 6 years

	All n=150		Girls n=74		Boys n=76		p ¹	Comparison data National/published	
Age, years	4.5	(0.9)	4.5	(0.8)	4.5	(1.0)	0.7		
Anthropometry									
Birth weight, kg, ²	3.0	(0.6)	2.8	(0.6)	3.2	(0.5)	0.2	-	3.1 ^a
BMI, kg/m ²	16.0	(1.8)	15.3	(1.7)	16.1	(1.9)	0.6	-	15.0 ^b
BMI z-score	0.1	(1.3)	0.1	(1.1)	0.1	(1.5)	0.2		
Weight status³									
Normal, %(n)	74.0	(111.0)	81.1	(60.0)	67.1	(51.0)	0.2	-	68.0 ^b
Underweight, %(n)	6.0	(9.0)	4.1	(3.0)	7.9	(6.0)	0.2	-	7.0 ^b
Overweight, %(n)	12.7	(19.0)	10.8	(8.0)	14.5	(11.0)	0.2	8.7 ^c	11.0 ^d
Obese, %(n)	7.3	(11.0)	4.1	(3.0)	10.5	(8.0)	0.2	2.5 ^c	8.6 ^d

All data are mean (SD) unless indicated.

¹ Comparison between groups using independent t-test for continuous normally distributed variables and Chi-squared for categorical variables.

² 17% missing data. ³ Weight status was defined according to the WHO growth reference 2006-2007.

^a Data from alnemer (2017) ⁽⁷⁵²⁾, ^b Data from Heba et al. (2017) ⁽⁴¹⁶⁾, ^c Data from El Mouazan et al. (2010) ⁽⁴¹⁰⁾, ^d Data from El-Gamal et al. (2020) ⁽⁴¹⁷⁾.

Table 6-3 Home environment and lifestyle characteristics of study participants (preschool children)

	All		Girls		Boys		p ²
	n=150		n=74		n=76		
Home environment							
Inside playroom/area, %(n)	87.3	(131.0)	87.8	(65.0)	86.8	(66.0)	0.1
Outside play area/yard, %(n)	58.0	(87.0)	58.1	(43.0)	57.9	(44.0)	0.9
Screen time ³							
<60 min/day, %(n)	54.0	(81.0)	55.4	(41.0)	52.6	(40.0)	0.6
>60 min/day, %(n)	46.0	(69.0)	44.6	(33.0)	47.4	(36.0)	0.7
Physical activity ⁴ ,%(n)							
<60 min/day, %(n)	43.3	(65.0)	47.3	(35.0)	39.5	(30.0)	0.3
>60 min/day, %(n)	52.7	(79.0)	48.6	(36.0)	56.6	(43.0)	0.3

All data are represented as %(n).

¹ Assessment of home environment and physical and screen time using questionnaire based on Raynor et al., (2008) and Alturki, Brookes and Davies (2018).

² Comparison between groups using Chi-squared test.

³ Screen time is defined by watching TV.

⁴ Time spent playing actively either inside or outside the home.

Table 6-4 Characteristics of infant feeding practices

	All		Girls		Boys		p¹
	n=150		n=74		n=76		
Initiation of breastfeeding² %(n)	88.0	(132.0)	90.5	(67.0)	85.5	(65.0)	0.3
Breastfeeding initiation (during the first hour), %(n)	41.7	(60.0)	18.8	(27.0)	22.9	(33.0)	0.4
Exclusive Breast Feeding (EBF)							
Duration of EBF, months	1.4	(0.4)	1.4	(0.5)	1.3	(0.4)	0.9
≥ 6 months, %(n)	6.0	(9.0)	6.8	(5.0)	5.3	(4.0)	0.7

All data are mean (SD) unless indicated

¹ Comparison between groups using Chi-squared for categorical variables

² initiation of breast feeding from the first day of giving birth.

Table 6-5 Characteristics of infant feeding practices

	All		Girls		Boys		p ¹
	n=150		n=74		n=76		
Any breastfeeding (Mixed feeding)							
Duration of any breastfeeding, months	9.3	(7.5)	10.6	(7.4)	8.1	(7.3)	0.3
≥ 4 months, %(n)	76.7	(115.0)	81.1	(60.0)	72.4	(55.0)	0.1
≥ 6 months, %(n)	64.0	(69.0)	71.6	(53.0)	56.6	(43.0)	0.5
Exclusive formula feeding (EFF)							
Age of formula feeding introduction, months	1.8	(1.9)	1.9	(1.9)	1.8	(1.9)	0.5
Duration of EFF, months	5.2	(0.7)	4.9	(0.2)	5.3	(0.9)	0.8
≥ 4 months, %(n)	10.0	(15.0)	6.8	(5.0)	13.2	(10.0)	0.1
≥ 6 months, %(n)	4.0	(6.0)	1.4	(1.0)	6.6	(5.0)	0.1
Complementary feeding							
Age of complementary feeding introduction, months	5.1	(1.4)	5.3	(1.4)	4.9	(1.4)	0.2
< 4 months, %(n)	8.7	(13.0)	5.4	(4.0)	11.8	(9.0)	0.1
< 6 months, %(n)	44.0	(66.0)	44.6	(33.0)	43.4	(33.0)	0.8
Pacifier Use, %(n)	47.3	(71.0)	39.2	(29.0)	55.3	(42.0)	0.05

All data are mean (SD) unless indicated.

¹ Comparison between groups using independent t-test for continuous normally distributed variables and Chi-squared for categorical variables

Table 6-6 Parental feeding styles and children eating behaviours (appetite traits)

	All		Girls		Boys		p ¹
	n=150		n=74		n=76		
Parental feeding style ²							
Instrumental feeding IF ³	3.2	(0.7)	3.2	(0.7)	3.2	(0.8)	0.2
Control C ⁴	3.3	(0.8)	3.4	(0.8)	3.2	(0.9)	0.1
Emotional feeding EF ⁵	2.1	(0.8)	2.1	(0.7)	2.2	(0.8)	0.4
Encouragement EN ⁶	4.2	(0.5)	4.2	(0.4)	4.1	(0.5)	0.6
Child eating behaviour/(Appetite traits) ⁷							
Food responsiveness FR ⁸	2.1	(0.7)	2.1	(0.7)	2.1	(0.7)	0.5
Emotional over-eating EOE ⁸	1.7	(0.6)	1.6	(0.5)	1.7	(0.6)	0.3
Enjoyment of food EF ⁸	3.2	(0.8)	3.2	(0.8)	3.2	(0.9)	0.6
Desire to drink DD ⁸	3.5	(0.2)	3.2	(0.2)	3.9	(0.1)	0.001
Satiety responsiveness SR ⁹	3.4	(0.6)	3.3	(0.6)	3.4	(0.6)	0.7
Slowness in eating SE ⁹	3.2	(0.6)	3.2	(0.7)	3.2	(0.5)	0.8
Emotional under-eating EUE ⁹	3.4	(0.7)	3.4	(0.8)	3.3	(0.7)	0.3
Food fussiness FF ⁹	3.1	(0.6)	3.1	(0.6)	3.1	(0.6)	0.8

All data are mean (SD) unless indicated. ¹ Comparison between groups using independent t-test for continuous normally distributed variables. ² Parental feeding styles were assessed using questionnaire by Wardle et al. (2002). ³ Refers to providing food as a reward. ⁴ Refers to imposing control over a child eating. ⁵ Refers to the management of the child's mood and behaviour by providing food. ⁶ Refers to providing encouragement to the child to eat. ⁷ Child eating behaviours were assessed using questionnaire by Wardle et al. (2001). Scores were measured on continuous scale of 0-5 points. ⁸ Food approach appetite traits. ⁹ Food avoidant appetite traits.

Table 6-7 Food preferences¹ of study participants (preschool children)

	All		Girls		Boys		p²
	n=150		n=74		n=76		
Carbohydrate preference score	3.8	(0.4)	3.9	(0.4)	3.8	(0.5)	0.5
Fruit preference score	3.5	(0.6)	3.6	(0.5)	3.4	(0.6)	0.9
Vegetables preference score	2.7	(0.6)	2.7	(0.6)	2.7	(0.5)	0.1
Dairy preference score	2.8	(0.6)	2.8	(0.6)	2.8	(0.6)	0.8
Meat preference score	3.2	(0.7)	3.2	(0.7)	3.2	(0.7)	0.9
Snacks preference score	4.0	(0.5)	4.0	(0.5)	4.0	(0.4)	0.5
Fast food preference score	3.7	(0.6)	3.6	(0.6)	3.8	(0.6)	0.5
Average weekly meals intake outside the home	2.5	(0.6)	2.4	(0.6)	2.6	(0.6)	0.1

All data are mean (SD) unless indicated.

¹ Food preferences were assessed using modified questionnaire by Fildes et al. (2014). Scores were measured on a continuous scale of 0-5 points.

² Comparison between groups using independent t-test for continuous normally distributed variables.

Table 6-8 Food frequency intake¹ and healthy plate variety score² (HPVS) of study participants (preschool children)

	All n=150		Girls n=74		Boys n=76		p ³
Carbohydrate							
Daily serving ¹	4.5	(1.0)	4.4	(0.9)	4.5	(1.2)	0.4
Group score ²	0.7	(0.1)	0.7	(0.1)	0.7	(0.1)	0.4
Fruits							
Daily serving ¹	1.2	(0.6)	1.2	(0.5)	1.2	(0.6)	0.8
Group score ²	0.6	(0.3)	0.6	(0.2)	0.6	(0.3)	0.8
Vegetables							
Daily serving ¹	1.4	(0.7)	1.4	(0.6)	1.3	(0.8)	0.4
Group score ²	0.5	(0.2)	0.4	(0.2)	0.5	(0.2)	0.4
Dairy							
Daily serving ¹	1.8	(0.9)	1.9	(0.8)	1.7	(1.0)	0.1
Group score ²	0.6	(0.3)	0.6	(0.2)	0.5	(0.3)	0.1
Meat							
Daily serving ¹	1.9	(0.5)	1.9	(0.6)	1.9	(0.5)	0.7
Group score ²	0.9	(0.2)	0.9	(0.3)	0.9	(0.2)	0.7
Healthy plate variety score ²	3.2	(0.6)	3.2	(0.6)	3.2	(0.7)	0.8

All data are mean (SD) unless indicated.

¹ Food frequency intake was assessed using modified food frequency questionnaire by Jarman et al. (2014).

² Food group intake score and HPVS were assessed following the methodology described by Jones et al. (2015).

³ Comparison between groups using independent t-test for continuous normally distributed variables.

Table 6-9 Associations of socio-demographic and parental factors with BMI z-score of preschool children

	Unadjusted ¹			Adjusted ²		
	β	(95% CI)	p	β	(95% CI)	p
Child						
Age, years ³	0.04	(-0.2,0.2)	0.8	0.01	(-0.2,0.2)	0.9
Sex, Male ³	0.01	(-0.3, 0.5)	0.6	0.1	(-0.3,0.5)	0.6
Mother						
BMI, (kg/m ²) ³	0.1	(0.002,0.1)	0.04	0.1	(-0.002,0.1)	0.05
Education; with degree ³	0.1	(-0.3,0.7)	0.4	0.1	(-0.3,0.7)	0.4
Working status	0.4	(0.02,0.8)	0.04	0.4	(0.03,0.9)	0.06
Informal care	0.6	(0.1,1.02)	0.006	0.6	(0.2,1.1)	0.003
Father						
Education; with degree ³	0.1	(-0.3,0.5)	0.7	0.1	(-0.4,0.6)	0.8
Social class; manual ³	-0.4	(-0.1,0.5)	0.3	-0.4	(-0.1,0.5)	0.3

¹ Unadjusted linear regression model.

² Adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class. ³ Variables excluded in multivariate models (if already included in univariate analysis).

Table 6-10 Associations of home environment and lifestyle factors with BMI z-score of preschool children

	Unadjusted ¹			Adjusted ²		
	β	(95% CI)	p	β	(95% CI)	p
Inside playroom/area	-0.004	(-0.6,0.6)	0.9	-0.1	(-0.7,0.5)	0.7
Outside play-area/yard	-0.5	(-0.9,-0.1)	0.01	-0.5	(-0.9,-0.1)	0.01
Screen time³						
<60 min/day, %(n)	-0.2	(-1.1,-0.2)	0.002	-0.2	(-1.1,-0.1)	0.005
>60 min/day, %(n)	0.2	(0.2,1.1)	0.001	0.2	(0.2,1.1)	0.003
Physical activity⁴						
<60 min/day, %(n)	0.1	(-0.2,0.6)	0.3	-0.1	(-0.1,0.7)	0.2
>60 min/day, %(n)	-0.2	(-1.1,0.6)	0.5	-0.2	(-0.6,0.2)	0.3

¹ Unadjusted model of linear regression.

² Adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

³ Screen time is defined by watching TV.

⁴ Time spent playing actively either inside or outside the home.

Table 6-11 Associations of infant feeding practices with BMI z-score at preschool age

	Unadjusted ¹			Adjusted ²		
	β	(95% CI)	p	β	(95% CI)	p
Exclusive Breast feeding (EBF)						
Duration of EBF, months	-0.1	(-0.2,-0.02)	0.01	-0.1	(-0.2,-0.02)	0.01
Never exclusively breastfed	0.4	(0.03,0.8)	0.03	0.4	(0.04,0.9)	0.03
Any breastfeeding (Mixed feeding)						
Duration of any breastfeeding, months	-0.03	(-0.1,-0.01)	0.01	-0.03	(-0.1,-0.003)	0.01
Exclusive formula feeding (EFF)						
Age of formula feeding introduction, months	-0.1	(-0.01,0.2)	0.1	-0.1	(-0.2,0.2)	0.1
Duration of EFF, months	0.1	(-0.01,0.2)	0.06	0.1	(-0.01,0.2)	0.05
Complementary feeding (CF)						
Age of CF introduction, months	-0.1	(-0.2,-0.02)	0.04	-0.1	(-0.3,0.01)	0.04
Pacifier use	0.8	(0.4,1.2)	0.0001	0.8	(0.4,1.2)	0.0001

¹ Unadjusted model of linear regression.

² Adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

Table 6-12 Associations of parental feeding styles and child eating behaviours/appetite traits with BMI z-score at preschool age

	Unadjusted ¹			Adjusted ²		
	β	(95% CI)	p	β	(95% CI)	p
Parental feeding style						
Instrumental feeding IF ³	0.2	(-0.01,0.4)	0.05	0.1	(-0.05,0.4)	0.1
Control C ⁴	-0.02	(-0.8,0.1)	0.7	-0.03	(-0.4,0.3)	0.8
Emotional feeding EF ⁵	0.1	(-0.1,0.3)	0.3	0.1	(-0.1,0.3)	0.5
Encouragement EN ⁶	-0.4	(-0.8,-0.02)	0.03	-0.4	(-0.8,-0.02)	0.04
Child eating behaviour/Appetite traits						
Food responsiveness (FR) ⁷	0.3	(0.1,0.6)	0.002	0.3	(0.1,0.6)	0.002
Emotional over-eating EOE ⁷	0.6	(0.2,0.9)	0.0001	0.6	(0.2,0.9)	0.001
Enjoyment of food EF ⁷	0.4	(0.2,0.7)	0.0001	0.5	(0.3,0.8)	0.0001
Desire to drink DD ⁷	0.1	(0.03,0.3)	0.01	0.2	(0.03,0.3)	0.01
Satiety responsiveness SR ⁸	-0.4	(-0.7,-0.1)	0.002	-0.4	(-0.7,-0.1)	0.005
Slowness in eating SE ⁸	-0.1	(-0.4,0.1)	0.1	-0.1	(-0.4,0.1)	0.2
Emotional under-eating EUE ⁸	-0.02	(-0.2,0.2)	0.9	-0.01	(-0.2,0.2)	0.9
Food fussiness FF ⁸	-0.1	(-0.4,0.1)	0.3	-0.1	(-0.4,0.1)	0.3

All data were measured on a numeric scale (0-5) using questionnaires developed by Wardle et al. (2001).¹ Unadjusted model of linear regression.² Adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class. ³ Refers to providing rewards for eating. ⁴ Refers to impose control over child's eating. ⁵ Refers to the management of the child's mood and behaviour by providing food. ⁶ Promote child to eat. ⁷ Refers to food approach traits. ⁸ Refers to food avoidant traits.

Table 6-13 Associations of child food preferences with BMI z-score of preschool children

	Unadjusted ¹			Adjusted ²		
	β	(95% CI)	p	β	(95% CI)	p
Carbohydrate preference score	0.3	(-0.1,0.5)	0.1	0.3	(-0.1,0.7)	0.1
Fruits preference score	-0.1	(-0.5,0.1)	0.3	-0.2	(-0.6,0.1)	0.1
Vegetables preference score	-0.2	(-0.1,0.5)	0.2	-0.2	(-0.6,0.1)	0.1
Dairy preference score	0.1	(0.1,0.5)	0.2	0.1	(-0.2,0.4)	0.5
Meat preference score	0.3	(0.05,0.7)	0.02	0.3	(0.03,0.7)	0.03
Snacks preference score	0.5	(0.1,0.9)	0.005	0.5	(0.1,0.9)	0.01
Fast Food preference score	0.3	(0.05,0.4)	0.02	0.4	(0.04,0.7)	0.02
Meals outside home	0.3	(0.01,0.6)	0.04	0.3	(-0.01,0.6)	0.06

¹ Unadjusted model of linear regression.

² Adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

Table 6-14 Associations of child food frequency intake with BMI z-score and healthy plate variety score (HPVS) of preschool children

	Unadjusted ¹			Adjusted ²		
	β	(95% CI)	p	β	(95% CI)	p
Carbohydrate daily serving	0.2	(0.0,0.4)	0.05	0.1	(-0.02,0.4)	0.08
Fruits daily serving	-0.3	(-0.6,0.02)	0.07	-0.3	(-0.7,0.01)	0.05
Vegetables daily serving	-0.3	(-0.6,-0.06)	0.01	-0.3	(-0.6,-0.04)	0.02
Dairy daily serving	0.1	(-0.04,0.4)	0.1	0.1	(-0.06,0.4)	0.1
Meat daily serving	0.3	(0.01,0.7)	0.04	0.3	(-0.07,0.7)	0.06
HPVS³	-0.03	(-0.4,0.4)	0.8	-0.1	(-0.5,0.40)	0.8

¹ Unadjusted model of linear regression.

² Adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

³ Food group intake score and HPVS were assessed following the methodology described by Jones et al. (2015).

Table 6-15 Associations of socio-demographic and parental factors with childhood overweight/obesity

	Not OWT/OB ¹		OWT/OB ¹			Unadjusted			Adjusted		
	n=120		n=30		p	OR (95% CI) ⁴		p	OR (95% CI) ⁵		p
Child											
Age, years ^{2,6}	4.3	0.8	5.1	0.8	0.0001	3.1	(1.7,5.6)	0.0001	3.1	(1.7,5.5)	0.0001
Sex, Male, %n ^{3,6}	47.5	57.0	63.3	19.0	0.2	1.9	(0.8,4.3)	0.1	1.9	(0.7,4.8)	0.1
Birth weight, kg ¹	3.0	0.6	3.1	0.5	0.7	1.1	(0.5,2.4)	0.7	2.7	(0.3,2.5)	0.9
Mother											
Age, years ^{2,6}	35.4	10.2	35.3	10.1	0.9	1.0	(0.9,1.0)	0.9	0.9	(0.9,1.0)	0.9
BMI, (kg/m ²) ^{2,6}	26.4	3.8	27.6	3.2	0.1	1.1	(0.9,1.2)	0.1	1.1	(0.9,1.2)	0.08
Education, university degree, %n ^{3,6}	77.5	93.0	76.7	23.0	0.9	0.9	(0.7,2.4)	0.9	0.6	(0.4,1.9)	0.4
Informal care, %n ³	48.3	58.0	76.7	23.0	0.007	3.5	(1.4,8.8)	0.007	3.8	(1.3,11.0)	0.01
Father											
Education, university degree, %n ^{3,6}	76.7	92.0	86.7	26.0	0.2	1.0	(0.6,0.6)	0.2	2.1	(0.6,7.7)	0.1

¹ Data is mean (SD) unless indicated; significance p<0.05. OWT/OB, overweight/obese.

² Comparison between groups using independent t-test.

³ Comparison between dichotomous groups using chi-squared test.

⁴ OR, odds ratio; CI, confidence interval; analysed using logistic regression.

⁵ Logistic regression model adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

⁶ Variables excluded in corresponding adjusted model.

Table 6-16 Associations of home environment and lifestyle factors with childhood overweight/obesity

	Not OWT/OB		OWT/OB			Unadjusted ¹			Adjusted ²		
	n=120		n=30		p	OR (95% CI)		p	OR (95% CI)		p
Home environment											
Inside playroom/area, %n	88.3	106.0	83.3	25.0	0.4	0.6	(0.2,2.0)	0.4	0.4	(0.1,1.6)	0.2
Outside play-area/yard, %n	64.2	77.0	33.3	10.0	0.002	0.2	(0.1,0.6)	0.003	0.2	(0.1,0.5)	0.002
Screen time ³											
<60 min/day, %n	58.3	70.0	36.7	11.0	0.05	0.4	(0.1,1.0)	0.05	0.3	(0.1,0.9)	0.05
>60 min/day, %n	41.7	5.0	63.3	19.0	0.03	2.4	(1.1,5.5)	0.03	2.9	(1.1,7.7)	0.02
Physical activity ⁴											
<60 min/day, %n	43.3	52.0	43.3	13.0	1.0	1.0	(0.4,2.2)	1.0	1.0	(0.4,2.6)	0.9
>60 min/day, %n	51.7	62.0	56.7	17.0	0.6	1.2	(0.5,2.7)	0.6	1.1	(0.4,3.0)	0.7

All data number (%); significance $p < 0.05$. OWT/OB, overweight/obese; min/day, minutes per day.

Comparison between dichotomous groups using chi-squared test

¹OR, odds ratio; CI, confidence interval; analysed using logistic regression.

² Logistic regression model adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

³ Screen time is defined by watching TV.

⁴ Time spent playing actively either inside or outside the home.

Table 6-17 Associations of infants' feeding practices with childhood overweight/obesity

	Not OWT/OB ¹		OWT/OB ¹			Unadjusted			Adjusted		
	n=120		n=30		p	OR (95% CI) ⁴		p	OR (95% CI) ⁵		p
Exclusive Brest Feeding EBF											
Duration of EBF, months ²	1.4	0.5	1.1	0.2	0.03	0.5	(0.3,0.8)	0.01	0.4	(0.2,0.8)	0.01
Never exclusively breastfed, %n ³	49.2	59.0	73.3	22.0	0.01	2.8	(1.1,6.8)	0.02	2.4	(1.4,9.7)	0.01
≥ 4 months, %n ^{3,6}	17.5	21.0	0.0	0.0	0.3		-			-	
≥ 6 months, %n ^{3,6}	7.5	9.0	0.0	0.0	0.1		-			-	
Any breastfeeding (Mixed feeding)											
Duration of mixed feeding, months ²	10.7	7.3	3.9	5.3	0.0001	0.8	(0.7,0.9)	0.0001	0.8	(0.7,0.9)	0.001
≥ 4 months, %n ³	84.2	101.0	46.7	14.0	0.0001	0.2	(0.06,0.3)	0.0001	0.3	(0.1,0.7)	0.01
≥ 6 months, %n ³	75.8	91.0	16.7	5.0	0.0001	0.1	(0.02,0.1)	0.0001	0.1	(0.03,0.2)	0.0001

¹ Data is mean (SD) unless indicated, significance p<0.05. OWT/OB, overweight/obese.

² Comparison between groups using independent t-test.

³ Comparison between dichotomous groups using chi-squared test.

⁴ OR, odds ratio; CI, confidence interval; analysed using logistic regression.

⁵ Logistic regression model adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

⁶ Logistic regression could not be applied because of the small sample size.

Table 6-18 Associations of infants' feeding practices with childhood overweight/obesity

	Not OWT/OB ¹		OWT/OB ¹			Unadjusted			Adjusted			
	n=120		n=30			p	OR (95% CI) ⁴		p	OR (95% CI) ⁵		p
Exclusive formula feeding (EFF)												
Age of FF introduction, months ²	2.1	0.2	1.1	0.7	0.007	0.6	(0.9,0.9)	0.01	0.6	(0.4,0.9)	0.02	
Duration of EFF, months ²	5.1	0.7	5.2	0.8	0.9	1.3	(1.0,1.6)	0.01	1.1	(0.9,1.4)	0.2	
≥ 4 months, %n ³	6.7	8.0	23.3	7.0	0.006	4.2	(1.4,12.1)	0.01	2.6	(0.6,7.7)	0.2	
≥ 6 months, %n ³	2.5	3.0	10.0	3.0	0.06	4.3	(0.8,22.7)	0.08	2.6	(0.4,16.2)	0.3	
Complementary feeding (CF)												
Age of CF introduction, months ²	5.3	1.3	4.2	1.4	0.001	0.5	(0.4,0.7)	0.0001	0.5	(0.3,0.7)	0.002	
< 4 months, %n ³	5.8	7.0	20.0	6.0	0.01	4.0	(1.2,13.0)	0.02	2.4	(0.5,10.2)	0.2	
< 6 months, %n ³	40.0	48.0	60.0	18.0	0.04	2.2	(0.9,5.0)	0.005	2.9	(1.6,10.1)	0.006	
Pacifier use, %n ³	41.7	50.0	70.0	21.0	0.005	3.2	(1.3,7.7)	0.007	3.1	(1.1,8.0)	0.02	

¹ Data is mean (SD) unless indicated; significance p<0.05. OWT/OB, overweight/obese.

² Comparison between groups using independent t-test.

³ Comparison between dichotomous groups using chi-squared test.

⁴ OR, odds ratio; CI, confidence interval; analysed using logistic regression.

⁵ Logistic regression model adjusted for age, sex, maternal BMI, maternal age, maternal education level, paternal education level and social class.

6.16 Discussion

The present study was conducted in the city of Makkah, which is situated in the western province of the KSA. It was found that children with overweight/obesity made up 20% (30/150) of the total sample size. This is in line with the findings of the systematic review, which was conducted as part of the current PhD project (see Chapter 2, section 2.4). The systematic review showed that the proportion of overweight/obesity in Saudi preschool children living in the western province ranged between 19% and 25%. The present study investigated several determinants of childhood obesity during preschool years in Makkah. These determinants included birth weight, developmental, behavioural, nutritional and lifestyle factors. These findings will be discussed below in the context of the previous research.

Birth Weight

Birth weight is known to be associated with childhood obesity; however, the current study did not detect any associations. Although this finding was consistent with a study of 554 Iranian preschool children (4-6 years), which also did not report any such association ⁽⁷⁵³⁾, a large body of evidence has documented the association between birth weight and childhood obesity ⁽¹⁵¹⁻¹⁵⁶⁾. For instance, a systematic review of 10 prediction models reported that birth weight is strongly associated with childhood overweight and obesity ⁽¹⁵⁴⁾. In addition, the secondary data analysis of an Early Childhood Longitudinal Birth Cohort conducted in the US found that every 100g increase in birth weight was associated with a 7% higher risk of developing overweight or obesity in preschool years ⁽¹³⁵⁾. Furthermore, the recent secondary analysis of data from a longitudinal and prospective nationally representative survey in Uruguay (including data from 2,114 children) found that macrosomic infants (>4 kg) had a higher prevalence of overweight/obesity compared to their healthy birthweight counterparts. That is, 70% of macrosomic infants developed overweight/obesity during preschool years ⁽⁷⁵⁴⁾.

Mechanisms underlying the possible association between high birth weight and the risk of childhood overweight/obesity are unclear. However, it was

reported that gestational obesity and higher maternal blood glucose levels may be associated with higher infant birth weights (>3.5 kg) ⁽⁷⁵⁵⁾. Larger infants may suffer from hyperinsulinemia and consequently rapid weight gain ⁽¹⁶⁰⁾.

The absence of such an association in the current study could be attributed to either missing data or subjectively reported data, as many mothers did not remember their children's exact birth weight. Apart from birth weight, other developmental factors, such as infant feeding practices, were associated with the development of childhood overweight/obesity according to the present study. This is discussed in the following sections.

Developmental factors

Overall, this study reported that infant feeding practices were far from meeting the WHO and UNICEF guidelines. The present study noted a low rate of early initiation of breastfeeding (during the first hour of the infant's life), as well as a low rate of exclusive breastfeeding for the first six months. In addition, infant feeding practices, (e.g. short duration of breastfeeding, early introduction of complementary food and the use of pacifiers) were associated with overweight and obesity, as discussed below in detail.

Early initiation of breastfeeding in the KSA (during the first hour of life)

In 1991, the WHO and UNICEF launched the Baby-Friendly Hospital Initiative (BFHI) to encourage breastfeeding practices by improving health facilities worldwide ⁽⁷⁵⁶⁾. Ten steps were recommended to promote breastfeeding, which included facilitating immediate and uninterrupted skin-to-skin contact, supporting mothers to initiate breastfeeding as soon as possible after birth, rooming-in mothers and infants for 24 hours a day, discussing the importance of breastfeeding with pregnant women and families, counselling mothers on the risks of bottle feeding and the use of pacifiers ⁽⁷⁵⁷⁾.

The impact of this initiative on breastfeeding and child health outcomes was evaluated via a systematic review of 58 studies (mixed designs and quality). This review reported that, out of the 58 included studies, 55 confirmed a positive association between BFHI steps applied and the likelihood of breastfeeding outcomes, such as early breastfeeding initiation and the

duration of exclusive breastfeeding (if any) ⁽⁴³⁸⁾. However, in terms of its implementation in the KSA, the BFHI has only been applied in 7% of Saudi Hospitals, accounting for only 28 out of 400 hospitals ⁽⁷⁵⁸⁾. This could explain the low rate of early breastfeeding reported by our study, in which only 22.9% of mothers successfully initiated breastfeeding in the first hour after delivery. This is similar to the findings of a recent cross-sectional study in the city of Hail, situated in the northern region of the KSA, which indicated that only 24% of mothers initiated breastfeeding within an hour of delivery ⁽⁷⁵⁹⁾.

There could be regional differences in the proportion of mothers who initiated breastfeeding in the first hour after giving birth. This is supported by the findings of a study that recruited 1,700 mothers from 165 health centres across the KSA. Regional variations showed a poor level of early breastfeeding in the northern region (26%), a fair level in the central, western and eastern regions (38.4%, 45% and 49% respectively) and a good level in the southern region (63%) ⁽⁷⁶⁰⁾. This regional variation might be attributed to differences in habits, customs and beliefs.

The phenomenon of delayed initiation of breastfeeding is also prevalent throughout the Middle East. This is supported by the findings of a review that included 19 observational studies. The meta-analysis found that only 34.3% of mothers living in Middle Eastern countries (including the KSA) were successful in initiating breastfeeding during the first hour of their child's life ⁽⁷⁶¹⁾. However, there was a high risk of recall bias in the included studies. Nonetheless, it is important to note that a low rate of early breastfeeding initiation is not only prevalent in the KSA and the Middle East, but it is a serious global problem. The WHO reported that globally, 3 in every 5 infants do not receive breastfeeding during the first hour after delivery ⁽⁷⁶²⁾.

Many studies have investigated the barriers to and enablers of the early initiation of breastfeeding. For example, a study of 814 Saudi mothers in the Makkah region pointed out that one significant factor associated with delayed initiation of breastfeeding is not rooming-in infants with their mothers after giving birth ($OR \approx 2.4$, $p < 0.001$) ⁽⁷⁶³⁾.

It is suggested that increasing mothers' awareness of the importance of breastfeeding and providing them with adequate information regarding the right time to initiate breastfeeding could be helpful in promoting breastfeeding practices. The large-scale cross-sectional study conducted by Ahmed and Salih (2019), which included 1,700 mothers recruited from different healthcare centres, found that mothers' awareness of the appropriate time for early initiation of breastfeeding was a significant determinant of compliance to the guidelines of early breastfeeding initiation ($p < 0.001$)⁽⁷⁶⁰⁾. Another recent qualitative study indicated that mothers perceive receiving information on breastfeeding in child healthcare meetings as a vital facilitator of the early initiation of breastfeeding⁽⁷⁶⁴⁾. It is therefore important to activate the BFHI in the KSA via legislation, in order to encourage better breastfeeding practices in Saudi mothers.

Unfortunately, the late initiation of breastfeeding has a major disadvantage, as it may adversely impact exclusive breastfeeding practice. For instance, late initiation of breastfeeding was found to be associated with the early introduction of formula feeding in the KSA ($p < 0.001$), according to a study that included 814 participants⁽⁷⁶⁵⁾. A study of 420 participants reported that 76.2% of infants in the KSA were introduced to formula feeding early (i.e. after birth, while they are still in the hospital)⁽⁷⁶⁶⁾. This may result in interruption of exclusive breastfeeding⁽⁷⁶⁷⁾, which was found to be associated with childhood overweight/obesity⁽⁷⁶⁸⁾. The section below considers the proportion of inadequate exclusive breastfeeding in the KSA according to the findings of the present study. Additionally, it discusses the potential influencers of early exclusive breastfeeding cessation in the region, as well as discussing the association between breastfeeding and the weight status of children.

Duration of exclusive breastfeeding

The WHO recommends that mothers breastfeed their infants exclusively up to the end of the 6th month⁽⁷⁶⁹⁾. However, the present study found that, although 88% of Saudi mothers were successful in initiating breastfeeding on the first day of delivery (regardless of whether it was early or late), only 6% continued to exclusively breastfeed their infants for 6 months.

These findings agree with those of many national and international studies ⁽⁷⁷⁰⁻⁷⁷²⁾. A consistent example includes the finding of a cross-sectional study conducted in Makkah, KSA. This study reported that 50.6% of newborns received exclusive breastfeeding at birth; however, only 14.4% were still being exclusively breastfed at 6 months ⁽⁷⁷³⁾. Another study conducted in the city of Jeddah (which is geographically close to Makkah), reported that 94.4% of children were breastfed when they were born, but only 13.7% of these infants were being exclusively breastfed at 6 months ⁽⁷⁷⁴⁾. A similar study conducted in the city of Taief, which is also geographically close to Makkah, found that 87.1% of participating mothers initiated breastfeeding, but only 16.3% of them exclusively breastfed their babies up to the age of 6 months ⁽⁷⁷⁵⁾.

There is a distinct regional variation of exclusive breastfeeding duration among the provinces of the KSA ⁽⁷⁷⁶⁾. For example, a study conducted in the eastern region of the KSA reported that 45.7% of mothers exclusively breastfed their infants for 6 months ⁽⁷⁷⁷⁾, while in the central region, the proportion of exclusive breastfeeding up to 6 months was 37.5% ⁽⁷⁷⁸⁾. Another study conducted in the southern region found that 28.9% of mothers continued exclusive breastfeeding for six months ⁽⁷⁷⁹⁾. This regional variation of exclusive breastfeeding rates in the KSA might be due to the differences in characteristics of each community among the 13 different provinces. Some areas are rural, while others are more urbanised. Level of education and consequent employment of mothers may also be different within regions. It may also depend on the different views regarding breastfeeding in each community. Consequently, further investigation of this issue is required.

Insufficient exclusive breastfeeding is not only prevalent in the KSA, but it also is a worldwide problem. For instance, the WHO reported that nearly 2 out of every 3 infants are not exclusively breastfed for the recommended 6 months ⁽⁷⁶²⁾. A multi-ethnic cohort study entitled, Growing Up in Singapore Towards healthy Outcomes (GUSTO), which included 960 participants, found that only 12% of children received exclusive breastfeeding for the first 6 months of their lives ⁽⁷⁸⁰⁾. In the US, the CDC reported that 25.1% of American infants who were born in 2017 received exclusive breastfeeding throughout their first 6

months⁽⁷⁸¹⁾. There are possibly distinct factors that may lead to early cessation of exclusive breastfeeding, as discussed below.

Potential influential factors of early exclusive breastfeeding cessation

There are many reasons behind the cessation of exclusive breastfeeding, such as young maternal age, sore breasts and nipples, fatigue due to breastfeeding, perceived inadequate breast milk, maternal choice, as well as baby-centred factors⁽⁷⁸²⁾. Not all of these reasons were reported as barriers to the continuation of exclusive breastfeeding in the KSA. However, the following section summarises the factors reported in previous studies conducted in the KSA and those identified as enablers of or barriers to the continuation of exclusive breastfeeding up to 6 months.

Knowledge, beliefs and attitudes could be important predictors of the discontinuation of breastfeeding. For example, a small cross-sectional study (n=124) conducted among university students in Tabuk, in the northern region of the KSA, reported that 54.9% of participants believed that breastfeeding would be painful. Additionally, 75.8% of participants believed that mothers would have more freedom if they used formula feeding⁽⁷⁸³⁾. Moreover, the perception of inadequate breast milk supply was mentioned as one of the reasons for the cessation of exclusive breastfeeding. A cross-sectional study in the Makkah region found that 18.6% of mothers believed that their breast milk was not sufficient for their infant's needs⁽⁷⁸⁴⁾, and 71.4% of Saudi mothers in Jeddah planned to provide mixed feeding⁽⁷⁷⁴⁾. Conversely, the perception of adequate supplies of breast milk were found to be associated with nearly 3 times higher odds of exclusive breastfeeding for 6 months (OR=2.9; p=0.001)⁽⁷⁶⁶⁾. Therefore, as well as advocating the importance of activating the BFHI policy, it is suggested that health authorities in the KSA address any misconceptions about breastfeeding via age-appropriate (e.g. teen-friendly) education sessions in schools.

It is also suggested to provide pregnant mothers with counselling sessions, in order to educate them about the benefits of exclusive breastfeeding. This is supported by a study that found mothers, who received counselling after

delivery, were 3.3 times ($p<0.001$) more likely to exclusively breastfeed their infants compared to those who did not ⁽⁷⁵⁹⁾. Unfortunately, in the study by Azzeh et al. (2018), which included 814 Saudi mothers, almost 80% of mothers said that they were not informed about the importance of breastfeeding ⁽⁷⁶⁵⁾. This sheds a great deal of light on the importance of raising mothers' awareness with regard to the benefits of breastfeeding, as well as providing them with counselling sessions to support better breastfeeding practices regardless of their educational level.

It was also reported that employment and higher levels of education are major factors for the early cessation of exclusive breastfeeding in the KSA. For example, a study that included 450 participants found that educated mothers were approximately 60% less likely to exclusively breastfeed their children compared to illiterate mothers ⁽⁷⁵⁹⁾. This is contrary to the situation in Western countries, wherein low education level and socioeconomic status are risk factors of childhood overweight/obesity ⁽⁷⁸⁵⁻⁷⁸⁷⁾.

One hypothesis that could explain the potential association between a higher level of education and the risk of a shorter duration of exclusive breastfeeding, is that mothers with a higher level of education are more likely to be working. Spending a long time outside the home when at work may interrupt exclusive breastfeeding. For instance, a study that included 589 Saudi mothers found that 96% of infants of working mothers were not exclusively breastfed by 6 months of age, a much higher percentage than the infants of unemployed mothers ($OR=0.04$; $p<0.001$) ⁽⁷⁸⁸⁾. Additionally, according to a study that included 614 Saudi mothers, the children of employed mothers had a higher risk of early formula feeding compared to children of unemployed mothers ($OR=1.7$; $p=0.02$) ⁽⁷⁷⁶⁾. This highlights the adverse impact of employment on exclusive breastfeeding.

If the employment authority does not impose legislation that supports breastfeeding mothers, then exclusive breastfeeding is likely to be interrupted. It is therefore recommended that policymakers in the KSA support employed mothers by providing maternity leave for at least 6 months after delivery instead of 10 weeks. It is also important to offer flexible working hours to

breastfeeding mothers after returning to work ⁽⁷⁸⁹⁾. It has been suggested that well-designed facilities should be established across the Saudi community to promote breastfeeding at any time according to infants' demands ⁽⁷⁶⁵⁾. The association between shorter breastfeeding duration and the risk of developing childhood overweight/obesity will be presented in the following section, with an emphasis on the possible mechanisms underlying this association.

Association between the short duration of breastfeeding and childhood obesity

The current study found that any amount of breastfeeding could help prevent childhood obesity. This is in line with the findings of a study conducted in the northern region of the KSA that included 142 preschool children. It was found that breastfeeding was more prevalent among preschool children with healthy weight compared to their peers with overweight/obesity (23% vs 7%) ⁽⁴²³⁾. Additionally, our findings are in agreement with those of a study conducted in the city of Arar, situated in the northern region of the KSA. This study investigated the relationship between breastfeeding and childhood obesity in children aged 2-12 years and found an association between the duration of breastfeeding and the risk of later childhood obesity. That is, 43% of children who received breastfeeding for less than 4 months were obese in their later childhood compared to those who received any breastfeeding for 6-12 months. The prevalence of obesity was 31.2% in children who received any breastfeeding up to 6 months, and 19.4% for children who were breastfed for up to a year ⁽⁷⁹⁰⁾. Moreover, our findings are consistent with those of a similar study conducted in the UAE (a neighbouring Arab country to the KSA), where the risk of developing overweight/obesity in preschool children was 90% lower in children who received any breastfeeding between 3-6 months compared with children who were not breastfed ⁽⁴²⁰⁾.

The findings of the present study also concur with the findings of a meta-analysis that investigated the association between breastfeeding and obesity during the preschool years (age 2-6 years). It included 26 high quality prospective cohort studies that involved 332,297 participants. This meta-analysis found a protective effect of breastfeeding against early childhood

obesity. Preschool children who were ever breastfed had a pooled odds ratio equivalent to 0.83 ($p=0.001$) compared to their counterparts who were never breastfed. The meta-analysis also supported the protective effect of breastfeeding for at least 6 months ($OR \approx 0.7$; $p=0.001$)⁽¹⁸⁵⁾. Another study on a multinational birth cohort of 8,676 participants found that exclusive breastfeeding for at least 3 months was associated with a decreased risk of obesity in preschool children at the age of 5.5 years ($OR \approx 0.7$; $p<0.05$). The study also found that any breastfeeding for a period of at least 6 months was associated with a decreased risk of obesity in preschool children at the age of 5.5 years ($OR=0.6$; $p<0.001$)⁽⁷⁶⁸⁾.

The mechanisms underlying the protective effect of breastfeeding against the development of early childhood obesity remain unclear⁽⁷⁹¹⁾. However, such a protective effect might be attributed to slower growth patterns in breastfed infants compared to formula-fed infants⁽¹⁹⁵⁾. Not only was breastfeeding associated with the risk of obesity in the present study, but the timing of complementary feeding introduction was also identified as a risk factor. This is discussed below.

The association of early introduction of complementary food with childhood obesity

The WHO recommends the introduction of complementary feeding at the end of the 6th month. However, the current study found that the mean age of complementary feeding introduction was 5.1 months, while some mothers in our study introduced complementary feeding as early as the second month. Although our study did not aim to investigate the types of complementary feeding, some mothers did disclose that they introduced pureed dates and honey to their children as early as the second or third month of life. These mothers believed that this would provide an optimum nutrient intake for their children. Furthermore, adding a spoonful of baby cereal or almond powder to formula milk was another practice that was believed to ensure a higher level of satiety to the infants.

The current study reported that the earlier introduction of complementary feeding was a determinant of childhood overweight/obesity. The risk of developing obesity in children who received complementary feeding before 6 months was 2.9 times higher than for children who received complementary feeding after 6 months. This is in line with the findings of the previous studies, in which the association of overweight/obesity was more pronounced when complementary feeding was introduced before the age of 4 months ⁽⁷⁹²⁾. For example, the findings from a prospective birth cohort study that included 847 infants supports the current study results. This cohort study found that the risk of obesity increased by 6-fold in preschool children who received both complementary feeding and formula earlier than 4 months ⁽²²⁹⁾. Additionally, data from four European birth cohorts found that the introduction of complementary food earlier than 4 months was associated with higher fat mass levels in 5-year-old French children ($p=0.02$) ⁽⁷⁹³⁾.

Contradictory findings, surprisingly, have been reported by a large cross-sectional study that included 10,808 children from 8 European countries. It was reported that children who received solid food earlier than 4 months were at lower risk of developing overweight/obesity (OR: 0.6, 95% CI 0.4, 0.8) ⁽⁷⁹⁴⁾. However, the cross-sectional nature of this study is a limitation, as well as a limitation of potential recall bias.

Other studies have not reported any association between early nutritional practice and the risk of developing overweight/obesity. For instance, a systematic review of 23 studies showed no clear association between the early introduction of complementary foods and the risk of developing childhood obesity ⁽⁷⁹⁵⁾. The ToyBox study, which is a large cross-sectional study that included more than 7500 participants from 6 European countries, reported similar findings. The study found no significant association between the early introduction of solid food and the development of childhood overweight during preschool years ⁽⁷⁹⁶⁾. These mixed results may be attributable to other factors, such as the type and quality of the solid food introduced to the child. Other factors that may mediate such an association include the duration of exclusive or any breastfeeding. Additionally, the study design might explain such

imprecise and inconsistent findings; that is, most studies were of an observational nature with high risk of recall bias ⁽⁷⁹⁷⁾.

Potential mechanisms that may link the early introduction of complementary food to the risk of developing childhood overweight/obesity are still yet unclear. Several hypotheses have been suggested. For example, it was proposed that protein intake increases through the provision of complementary food ⁽²²⁵⁾. This may be associated with obesity in accordance with the early protein hypothesis ⁽²¹²⁾, which suggests that a higher intake of protein increases plasma concentrations of insulin-releasing amino acids, stimulating the secretion of insulin and insulin-like growth factor I (IGF-I), and in turn, enhances body fat deposition and weight gain ⁽⁷⁹⁸⁾. It is suggested that elevated branched-chain amino acids (BCAAs), especially leucine, might be associated with obesity ⁽⁷⁹⁹⁾ due to its role in stimulating the appetite and increasing food intake ⁽⁸⁰⁰⁾.

A high sugar intake has also been suggested to increase the risk of obesity in young children. It has been suggested that commercial ready-to-eat complementary foods are associated with higher sugar intake, which could result in a positive energy imbalance ⁽²⁴²⁾.

Association of pacifier use with overweight/obesity during childhood

The WHO and UNICEF recommend the avoidance of pacifiers ⁽⁷⁵⁷⁾. However, the present study found that 47.3% of participants provided their infants with pacifiers. Importantly, this association was independent of confounding factors, such as SES and mother's education that could influence pacifier use. According to the present study findings, infants who were given pacifiers were 3.1 times more likely to develop overweight/obesity than those who were not. This is consistent with the findings of an earlier study that investigated the duration of pacifier usage and its relationship with childhood overweight/obesity. This study reported that each month of pacifier usage was found to be associated with a 1.1 times higher likelihood of developing overweight in children aged 2 years ⁽⁸⁰¹⁾.

The association of pacifier usage with the risk of obesity that was reported by the present study might be attributed to adding honey or date molasses to the

pacifier by some mothers. These mothers believe that such supplements have a high nutritional value. It should be noted that this was reported randomly in separate cases during the study, and the present study did not focus on such practices or beliefs. Therefore, we recommend that future studies should carry out an in-depth investigation of beliefs and types of feeding practices associated with pacifier usage by Saudi mothers. This would help inform interventions that are aimed to address inappropriate beliefs in terms of infant feeding.

Additional potential explanation for the link between pacifier usage and the risk of developing overweight/obesity is through the interruption of breastfeeding⁽⁸⁰²⁾. Two studies conducted in the Makkah region investigated the association between pacifier usage and the early cessation of breastfeeding. It was found that using a pacifier during the first 6 months of life was associated with a 1.6-fold greater risk of early breastfeeding cessation compared to not using pacifiers^(763,773). These findings are consistent with those of a systematic review and meta-analysis of 44 studies, including 20 prospective cohort studies. Most included studies were of a moderate to high quality, and this meta-analysis found that the use of a pacifier was associated with a ≈ 2.3 times higher risk of exclusive breastfeeding interruption during the first 6 months of an infant's life⁽⁸⁰³⁾.

In addition to the factors reported above, the findings of the present study also found a link between child eating behaviours and parental feeding styles with the risk of developing childhood overweight/obesity, as discussed below.

The association of child eating behaviours and the risk of developing childhood overweight/obesity

In the present study, food approach traits including food responsiveness, emotional overeating, the enjoyment of food and desire to drink more were positively associated with higher BMI z-scores in Saudi preschool children. In contrast, satiety responsiveness was negatively associated with child BMI z-scores. This is in line with a large body of evidence that supports the present study's findings, which suggest that child eating behaviour is linked to the risk

of developing childhood overweight/obesity. According to previous studies, food approach traits were found to be positively associated with child weight, while food avoidant traits were found to be negatively associated ^(251,424,804).

It is hypothesised that food approach appetite traits are associated with the desire to eat more, which results in a higher calorie intake than those expended, leading to positive energy imbalance and consequent weight gain. In contrast, a negative energy imbalance is associated with food avoidant traits and a lower weight status. The mechanism underpinning the association between eating behaviour and weight status is still unclear ⁽⁸⁰⁵⁾, but it is likely that a combination of genetic and biological factors, as well as environmental and cultural influences that interacts to shape child eating behaviours ⁽²⁴³⁾. It is recommended that further studies be conducted to provide an adequate understanding of these mechanisms.

Association of parental feeding style with childhood overweight/obesity

As far as the association of parental feeding styles with childhood overweight and obesity is concerned, the present study found that an encouragement to eat feeding style was associated with lower risk of childhood overweight/obesity. This is in line with the findings of a cross-sectional study conducted on 1,201 Turkish school-age children, which found that encouragement to eat was negatively associated with child BMI ($p < 0.01$) ⁽²⁵⁰⁾. Other consistent findings were reported by a cross-sectional study conducted in China that included 930 families with preschool children aged between 2 and 6 years. This study found that encouragement to eat was negatively associated with the odds of developing overweight during preschool years. That is, higher scores on the encouragement to eat scale were associated with an 80% lower risk of developing childhood obesity ($OR = 0.2$, $p < 0.001$) ⁽⁸⁰⁶⁾.

Links between lower tendencies of developing childhood overweight/obesity and encouragement to eat may be explained by the potentiality of improving dietary habits in children. Parents would most probably encourage eating healthy foods, in particular. For instance, the findings of a large survey of preschool children conducted in Hong Kong found that encouragement to eat

was associated with higher odds of consuming the recommended intake of fruits, vegetables and dairy ⁽²⁶⁷⁾. Another study found that encouragement to eat healthy foods was associated with a lower intake of energy-dense snacks ⁽²⁶⁰⁾.

Overall, there is inconsistency in the findings of previous research with regard to the association between the encouragement to eat feeding style and the development of childhood overweight/obesity. For example, in contrast to the negative association between encouragement to eat and childhood obesity reported in the present study, another study has reported that encouragement to eat was positively associated with approaches to food ($p < 0.001$) ⁽²⁶¹⁾. This could result in over-consumption and hence, weight gain in children ⁽⁸⁰⁷⁾. Other studies reported no significant association ⁽⁸⁰⁸⁻⁸⁰⁹⁾.

The inconsistency of findings in the context of links between childhood overweight/obesity and parental feeding behaviour may be attributed to different ethnicities and cultural backgrounds that may have an impact on parental feeding behaviour ^(258; 810-811). Additionally, the observational nature of most studies and the short duration of the follow-up period in prospective cohort studies may explain the inconsistency of findings. It is therefore proposed that randomised controlled longitudinal studies should be conducted with a sufficient follow-up period to clarify any causal pathways between parental feeding styles and children's weight status. An investigation into beliefs and attitudes in different communities that might mediate such an association is also recommended.

Dietary factors

The current study found that diets of preschool children were associated with the risk of developing obesity. A higher preference for snacks and fast food were positively associated with a higher BMI z-score in children, after adjusting for confounding factors. In contrast, the consumption of vegetables was associated with less excess weight gain. This is in agreement with the findings of a recent study conducted in the southern region of the KSA. This study found that daily intake of animal protein, frequent consumption of soft drinks, crisps,

as well as the low intake of fruits and vegetables were associated with the risk of developing overweight/obesity in Saudi preschool children ⁽⁴²⁵⁾.

Overall, the findings of the present study concur with the previous literature. For example, a recent systematic review of 16 cross-sectional studies concluded that foods that are classified as obesogenic (including fast food, snacks, candies, cakes and animal products) are associated with the risk of developing overweight and obesity in children (1-18 years). Conversely, diets classified as healthy (including a higher consumption of fruits and vegetables, whole grains, fish, legumes and nuts) are associated with a reduced risk of childhood overweight/obesity ⁽⁴⁵¹⁾.

Studies investigating associations between dietary patterns and the risk of developing childhood overweight/obesity in the Middle East are scarce, particularly in preschool children. Nonetheless, studies targeted at older children could be relevant. For instance, a systematic review of dietary factors associated with mid-childhood (6-12 years) obesity in the Middle East identified only 4 relevant papers. It was reported that high consumption of refined carbohydrate and fats could be considered as risk factors for the development of childhood obesity in the region, along with a low intake of fruit and vegetables ⁽⁸¹²⁾. These findings are, partially, in agreement with the results of the present study. Further discussion is provided below.

Vegetable intake

Some studies investigated the combined role of fruits and vegetables on the risk of childhood overweight/obesity, while others - including the present study - investigated their roles separately. In the current study, a negative association was found between BMI z-score and the frequent consumption of vegetables, but not fruit. This is in line with the finding of a systematic review, which included 10 cohort studies that aimed to evaluate the current evidence regarding the impact of vegetables intake alone (not combined with fruit) on weight status. This review supports the inverse association between vegetable intake and weight-related outcomes by moderately strong evidence ⁽⁸¹³⁾.

Not finding an association between fruit intake and child weight status may be explained by the fact that fruit compared with vegetables are different in nutritional composition. For instance, the review conducted by Nour et al. (2018) reported that, although fruits and vegetables exhibit similar properties, they differ in terms of their nutritional composition ⁽⁸¹³⁾. In particular, non-starchy vegetables contain more water and fibre in comparison to sweeter fruits, which are high in sugar ⁽⁸¹³⁾.

The inability to detect a significant association between fruit intake and lower risks of childhood obesity according to the current study findings does not mean that fruit is not associated with children's risk of overweight/obesity. It is possible that the variance of fruit consumption in the present sample might have been too small to allow a discovery of an association with BMI z-scores. According to the current literature, the association between consumption of fruits and vegetables and child weight status might not always be detected ⁽⁸¹⁴⁾. For instance, a large-scale survey of preschool children (4-7-year-olds) from 6 European countries reported mixed findings in terms of the association between fruits and vegetables consumption and child weight status ⁽⁴³⁷⁾. The authors suggested that the lack of association may have been attributable to methodological limitations, especially given the wide variation of measures used across the studies investigated. More studies are therefore needed to confirm the association between fruits and vegetables intake and child weight status.

Macronutrients

Previous studies in the literature did not provide adequate evidence regarding the association between fat or carbohydrate intake and weight status in preschool children ⁽⁸¹⁵⁾. However, Rolland-Cachera et al. (1995) were the first to point out the potential adverse effects of higher protein intake on the BMI of toddlers at the age of 2 years ⁽⁸¹⁶⁾. Since then, many studies have found a positive association between higher protein intake and the risk of childhood obesity. These include studies that targeted preschool Indian children ⁽⁸¹⁷⁾, Australian children ⁽⁸¹⁸⁾ and American children ⁽⁸¹⁹⁾. Reviews by Lanigan (2018) ⁽⁴⁷⁴⁾ Ferré et al. (2021) ⁽⁸²⁰⁾, and Arnesen et al. (2022) ⁽⁸²¹⁾ confirmed a positive

correlation between protein intake and weight status. However, the present study did not detect such association.

The absence of association between protein intake and weight status of participated children might be attributed to the fact that the analysis of the present study was based mainly on the frequency of protein intake without considering its quantity or the type and without adjusting for total energy intake. It is worth noting that some studies attribute such adverse effect to animal protein, in particular, rather than plant-based protein ⁽⁸²²⁾. For example, a cohort study investigating the impact of animal protein on growth factors in infants up to 6 years of age found that higher animal protein intake (more than 12% of total energy intake) resulted in 0.8 kg/m² higher BMI compared to children who received protein intake that was less than 7% of total energy consumption ⁽⁸²³⁾. The mechanisms underlying this association could possibly be explained by the “early protein hypothesis” mentioned earlier. However, more studies on this are required, which include the consideration of type and quantity, in order to clarify the association between protein intakes in early life and childhood overweight/obesity.

According to the present study, carbohydrate intake was not linked to weight gain in preschool children. This is in line with the findings of a systematic review involving 22 studies, which reported a weak association between high carbohydrate diets and the risk of obesity compared to low carbohydrate diets ⁽⁸²⁴⁾. However, there was a heterogeneity between the included studies, such as population, age and sex. Another important limitation was the inconsistency of measures used to quantify carbohydrate intake across studies. In addition, the included studies did not classify the types of carbohydrate investigated. Thus, further studies with standardised measuring tools should be carried out, particularly to investigate the impact of refined carbohydrates compared to unrefined carbohydrates on weight status.

The consumption of beverages sweetened with sugar has increased among children ⁽⁸²⁵⁾ and such drinks are considered a major source of refined carbohydrate ⁽⁸²⁶⁾. The excessive consumption of sugar-sweetened beverages is expected to result in weight gain ⁽⁸²⁷⁾. For example, a systematic review of

32 studies found an association between SSB intake and the risk of obesity in children aged 2-18 years ⁽⁸²⁸⁾. Additional studies published after that systematic review found that the frequent consumption of SSB was associated with a 1.5 times greater risk of developing obesity in Portuguese ⁽⁸²⁹⁾ and Chinese preschool children ⁽⁸³⁰⁾. Restricting refined carbohydrate intake could therefore be helpful for weight management in children.

The potential positive impact of minimising SSB intake on weight outcomes can be exemplified by the findings of a study by Pauley et al. (2021), which included school aged children (5-18 years). The study included 310 children and was designed to minimize the amount of refined carbohydrates, such as added sugar in children's diets. The results indicated that a restricted carbohydrate diet effectively reduced weight in severely obese participants ($p < 0.01$) ⁽⁸³¹⁾. However, more studies are needed to investigate such associations in younger children during preschool years.

Unfortunately, in the KSA, studies investigating the macronutrient intake of preschool children and their association with weight status are scarce. However, a relevant study was conducted in the northern region of the KSA and looked at dietary intake of preschool children in association with the risk of developing overweight and obesity. This study found that daily intake of animal protein and frequent intake of soft drinks was associated with the risk of developing preschool obesity ⁽⁴²⁵⁾. Another relevant study conducted on older Saudi girls (6-12 years) reported that protein intake is generally high among Saudi school-aged children. This study reported that protein consumption contributed to 20.5% of the total energy intake ⁽⁸³²⁾.

The limited number of studies investigating dietary intake of Saudi preschool children hampered the ability to make a comparison between the present study results and other relevant research in the region. However, it might be possible to at least gain an insight into Saudi children's diet by looking at dietary intake of Saudi adults. This is because children's food intake may be significantly influenced by their parents' diet ⁽⁸³³⁾. The findings of a meta-analysis of 43 studies from 11 countries in the eastern Mediterranean region might be relevant. The review was aimed at estimating the percentage of energy intake

from macronutrients between 1961 and 2018. The analysis found that the KSA demonstrated the highest total energy intake from protein compared to other countries, accounting for 18.9% ⁽⁸³⁴⁾. This figure exceeded the Recommended Dietary Allowance (RDA) for protein intake (10-15%). A high total energy intake from carbohydrate in the KSA was also reported (65.5%). Further investigations of dietary intake of parent-child dyads in relation to the risk of developing obesity in the KSA are required to help in addressing such epidemic.

It is important to bear in mind that the aetiology of obesity is multifactorial. A complex interaction of distinct factors may result in excess weight gain, and each factor may only make a small contribution to the process ⁽⁸³⁵⁾. Thus, it is not clear to which extent higher protein and starch intakes may be considered as determinants of weight gain in Saudi preschool children.

Following the discovery of oil in the KSA during the 1960s, the lifestyle and eating habits have changed ⁽⁴⁰²⁾. For instance, the invasion of the fast food industry and the growing prevalence of eating out have become a prominent feature in Saudi lifestyles ⁽⁸³⁶⁾. The following section will discuss the adverse effects of fast food restaurants on weight status in the KSA in accordance to the findings of the present study.

Fast food and snacks

The current study found a positive association between child BMI z-score and preferences toward fast food restaurants as well as snacks. This corroborates existing evidence in the literature, which indicates that a higher intake of fatty food is associated with childhood overweight/obesity ⁽⁸³⁷⁾. This is probably because energy-dense foods that are high in saturated fats and added sugar (e.g. cake, chocolate and pizza) could lead to a positive energy imbalance that could contribute to weight gain ^(252; 838-839). A consistent example can be seen in the findings of studies conducted in a prospective cohort in the US, which included 541 preschool children aged between 3 and 5 years. This study reported that the average frequency of fast food consumption was 2.1 times per week. The risk of gaining excess weight increased by 38% for each

additional intake of fast food per week ⁽⁸⁴⁰⁾. Similar associations were also found in studies conducted in Greece ⁽⁸⁴¹⁾ and Egypt ⁽⁸⁴²⁻⁸⁴³⁾.

There is a paucity of studies investigating the association between fast food intake and the risk of developing obesity during preschool years in the KSA. However, studies that included school aged children could be relevant. One study of 1,023 Saudi school children (9-11 years) reported that 3-4 weekly instances of fast food meals were associated with ≈ 5.4 -fold odds of developing obesity in these children ($p < 0.0001$) ⁽⁸⁴⁴⁾.

Fast food is not only dense in energy and poor in nutritional value, but also usually provided in large portion sizes. This may explain the association between a high consumption of fast foods and the risk of developing overweight and obesity. It is well documented in the existing literature that large portions of energy-dense food is associated with higher energy intake, thus contributing to the development of obesity ⁽⁸³⁹⁾. The “supersizing” of menu items has become a common phenomenon over the last 40 years ⁽³⁴⁷⁾. This might be attributed to technological advances in food production, which facilitates the production of large quantities of fat and sugar at a very low prices ⁽³⁴⁸⁾. Also, genetic modification and hormonal injections encourage the faster production of animal and plant produce to meet increased consumer demands ⁽⁸⁴⁵⁾, enabling fast food companies to produce larger portion sizes at cheaper prices ⁽³⁴⁹⁾.

Offering customers a larger meal at a lower price is a sales strategy designed to increase the popularity of fast food restaurants, by encouraging consumers to buy more ⁽⁸⁴⁶⁾. These strategies have been found to be effective in increasing overall sales ⁽⁸⁴⁷⁾. Buying larger portions is likely to influence food intake. A meta-analysis supporting this, looked at 15 studies investigating the effects of enlarged portion sizes on the amount of food intake in children aged 2-12 years. The pooled analysis found that a 51-100% increase in children’s portion sizes was associated with a 13% higher food intake ⁽⁸⁴⁸⁾. Menus of fast foods restaurants would usually consist of a less healthy food items. A supportive example includes a study that analysed 2,472 food items offered on the menus of the 14 highest-earning fast food restaurant chains in the US. This study

reported that fewer than 20% of these items were classified as healthy, while most other food items were classified as less healthy (i.e. high in saturated fats and sugar) ⁽⁸⁴⁹⁾.

It is suggested that easier access to fast food restaurants is associated with higher food consumption and potential weight gain. A large national cohort study of 944,487 Swedish children (<14 years) reported a higher probability of the development of childhood obesity in neighbourhoods with easy access to fast food restaurants (OR≈1.1; $p<0.05$) ⁽⁸⁵⁰⁾. Another longitudinal study conducted in the UK, which included 1,577 children under 11 years old, had reported that easy access to fast food outlets was associated with a higher risk of gaining excess weight (OR≈1.9, $p=0.04$) ⁽⁸⁵¹⁾.

Although a positive correlation between easy access to fast food restaurants and higher rates of childhood obesity was suggested, as indicated above, mixed findings concerning such a link were reported by a systematic review and meta-analysis of 87 studies from 14 different countries ⁽³⁵⁵⁾. These mixed findings of associations between accessibility to fast food restaurants and overweight/obesity may be mediated by factors such as socioeconomic status and quality of diet ⁽⁸⁵²⁾. More studies are needed to provide a thorough understanding of such possible associations. Later through this chapter, the findings of the present study will be discussed within the context of socioeconomic and cultural factors influence. In addition to examining the association between childhood obesity and diet, the present study looked at lifestyle factors, as discussed below.

The association between lifestyle factors and the risk of developing childhood overweight/obesity

Physical activity

The present study found the availability of an outside play area in the house as a protective factor against the risk of developing childhood overweight/obesity. However, no association was detected between the total time spent on physical activity and child BMI z-scores. The absence of such an association in the present study may be attributable to the fact that physical

activity was reported by the parents, and their assessment of their child's activity level might not be accurate. Similarly, the lack of any association between time spent on physical activity and child BMI z-scores was reported in another study that analysed data from five cross-sectional studies. That study concluded that differences in physical activity were not associated with child BMI levels ⁽³⁰⁷⁾.

Mixed findings are reported in the literature concerning the association between physical activity and overweight/obesity in preschool children ⁽⁸³⁹⁾. A meta-analysis of 15 cross-sectional studies showed no association between physical activity and BMI rates in children. However, 5 longitudinal studies have shown mixed results; two of these found no association, two reported a negative association and one study rather unexpectedly reported a positive association between child BMI and a higher level of engagement in moderate-to-vigorous physical activity ⁽⁸⁵³⁾. These mixed results might be attributable to methodological limitations or study design, which may hinder the accuracy of longer-term associations. In addition, using the BMI as a measure of obesity does not take into account the potential development of muscle mass as a result of high intensity physical activity. Thus, interpretation of findings should be cautious.

The distinct tools used to examine the associations between physical activity and childhood overweight/obesity may explain the mixed findings. For example, a systematic review of 56 articles reported that studies that use questionnaires were not likely to detect any association, since the physical activity of children is reported subjectively by parents who may not provide an accurate measurement. Using accelerometers detected an association in 72% of studies, whereas, all studies that used pedometers to measure physical activity found a negative association between physical activity and overweight/obesity ⁽⁸⁵³⁾. Thus, it is possible that detecting associations between physical activity and overweight/obesity in preschool children may depend on the tools used to examine this association.

Screen time

In the present study, screen time was identified as a risk factor for developing overweight/obesity in Saudi preschool children. This is consistent with previous literature. For example, not meeting screen time recommendations in 254 Chinese preschool children (4-6 years) was associated with a ≈ 3.8 -fold higher risk of developing overweight/obesity in comparison to meeting such recommendations ⁽⁸⁵⁴⁾. Additionally, in Kuwait (a neighbour country to the KSA), not meeting the recommendation for screen time was associated with a higher risk of developing overweight/obesity in preschool children by 5.6-fold compared to meeting such recommendations in a sample of 5,304 subjects ⁽⁴²⁷⁾. The findings of the current study are also in line with those of a study on 526 preschool children (3-6 years) in the European Childhood Obesity Project (CHOP). Analysis of CHOP found a positive association between longer screen times and higher BMI rates in preschool children. Each additional hour of screen time during the 4-year period resulted in almost double the risk of developing overweight/obesity at the age of 6 year old ⁽⁴⁴³⁾.

The positive association between the risk of childhood obesity and higher exposure to screen time could be attributed to the associated eating behaviours. For instance, a systematic review of 20 articles showed that 75% of included studies indicated a positive association between eating while watching TV and higher risks of childhood overweight/obesity ⁽⁴⁴⁴⁾. Another systematic review found that 4 out of 5 studies reported that children eat and drink while watching TV. This eating pattern was associated with higher consumption of sugar-sweetened beverages and snacks ⁽⁸⁵⁵⁾. Moreover, a pooled analysis of a sample of preschool children from 6 European countries found a positive association between eating while watching TV in these children and higher BMI ($\beta=0.6$, 95% CI 0.09 to 1.2) ⁽⁴³⁷⁾.

In addition, socioeconomic and cultural factors are considered as risk factors for childhood overweight/obesity. The section below discusses the findings of the present study within such context.

Socioeconomic, demographic and cultural factors

Socioeconomic status (SES) can be evaluated by looking at factors such as income, occupation and level of education ⁽²⁸⁹⁾. In the current study, socioeconomic status was defined by father's occupation (manual vs non-manual), but showed no association with child weight status. The absence of association might be explained by the fact that the sample was chosen from a private school. It is likely that most of the participants were already of a high social class. The comparison with lower social class was potentially hindered and hence, any association was not detected. Nonetheless, it is proposed that the lack of a common definition of SES between previous studies increased heterogeneity and prevented a clear understanding of its association with childhood obesity ⁽⁸⁵⁶⁾. Further investigation is needed into this issue using a consistent definition of SES to identify its influence on the risk of developing overweight/obesity across Saudi Arabia's 13 provinces.

Regardless the absence of any association between SES (defined by father's occupation) and the risk of developing childhood obesity, in this study, the potential association between working mothers and childhood overweight/obesity was reported by other studies conducted in the KSA ^(436; 857-858). It is possible that mothers with full-time job may seek the assistance of relatives or domestic helpers in looking after their children. The role of child informal care is discussed below.

The influence of informal care (e.g. by grandparents and domestic helpers)

The present study found that informal care provided by relatives, such as grandparents, older siblings, other family members or domestic helpers, was associated with the risk of developing overweight/obesity in Saudi preschool children. This is consistent with the findings of previous systematic reviews, which confirmed the association between informal care (by relatives, friends or neighbours) with developing overweight/obesity in young children ^(399; 859-860). However, the included studies were of an observational nature, which hindered establishing a causal association.

In line with the present study findings, a longitudinal data analysis of 8,039 Irish preschool children found that the risk of developing overweight increased by 8.1% in 3-year-old children with highly educated parents in full-time employment, who sought informal care (e.g. either relatives or childminder) to take care of their infant from the age of 9 months ⁽⁸⁶¹⁾. Additionally, data from 267 Hispanic families found that the odds of developing overweight/obesity in 2-year-old children living with grandparents (vs none) was 4.3 times higher ⁽⁴⁰⁰⁾. Further similar findings to the present study results were reported by Cevik et al. (2019). They conducted a study in Turkey, and included 1,061 Turkish preschool children aged 3-5 years. It was reported that the risk of developing excess weight was 2.5 times higher for children who lived in an extended family than it was for children who lived in a nuclear family ⁽⁸⁶²⁾.

There are several explanations for the association between childhood obesity and receiving informal care (e.g. by relatives or domestic helpers). It is suggested that mothers' full-time employment might be associated positively with seeking informal care. This, for example, includes hiring domestic helpers. It is possible that the dietary habits of domestic helpers might be mirrored in the dietary habits of children. However, this aspect has not yet been adequately studied. Hence, more in-depth research is needed to help in understanding the influence of informal care on child weight status.

The social construct of the Saudi community (i.e. extended families living together) may also explain such an association. For instance, grandparents, who actively participate in caring for their grandchildren, might be holding unhelpful beliefs, such as "bigger is better". They also might not be aware of the updated recommendations for a healthy life; thus, they might permit their grandchildren to consume less healthy foods. Further investigation of this area would be helpful in drawing a clear conclusion with regard to the influence of informal care on the risk of developing overweight and obesity during preschool years.

6.17 Chapter Summary

Overweight and obesity during the preschool years are prevalent in the KSA. However, there is a paucity of studies that have investigated risk factors of childhood overweight and obesity in the region. The current study aimed to fill this gap in the literature. It identified several factors as determinants of overweight/obesity in Saudi preschool children living in the city of Makkah. This included, short duration of exclusive breast feeding, less healthy dietary habit (e.g. high preference of fast food) and not meeting the screen time recommendation. Additionally, child informal care (i.e. by grandparents or domestic helpers) was a risk factor for childhood overweight/obesity in the KSA. Overall, the findings of the present study were in line with the previous literature.

The current study did not detect an association between the time spent in physical activity and the childhood overweight/obesity. However, the presence of an outside play area was found to be protective against the risk of obesity. Thus, the absence of an association between the time spent being physically active and the risk of developing childhood overweight/obesity may be attributed to the methodological limitation of the current study. This is because assessing physical activity was based on using questionnaires completed by mothers. Reporting such data might not be precise and hence, such an association was not clear.

In terms of the impact of socioeconomic status, the present study defined it according to father's occupation (manual vs non-manual). However, no association was detected. The absence of such an association might be explained by the fact that the sample was chosen from a private school, in which most of the participants were already of a high socioeconomic status. This hinders comparison with, and generalisability to children of lower socioeconomic status.

While this chapter focused on understanding determinants of childhood overweight/obesity in Saudi Arabian preschool children, the next chapter is a

qualitative research study that aims to provide in-depth information on the acceptable format and mode of delivery of a potential healthy lifestyle intervention for Saudi preschool children and their families. This was achieved through conducting interviews with Saudi mothers and focused on understanding barriers and enablers of participation in such an intervention. It also considered providing an insight into barriers to a healthy lifestyle from Saudi mothers' point of view. This will be helpful to inform the design of an appropriate intervention to this population. Most importantly, such information, taken together with the present study findings, would inform the appropriate cultural adaptation of a successful intervention such as the Trim Tots.

7. Chapter 7: Study 2 Results: Qualitative research concerning mothers' perceptions of childhood obesity and barriers of participation in lifestyle intervention conducted in the KSA

7.1 Introduction

Obesity is a multifactorial disorder. A deep understanding of its roots is needed, and designing an appropriate intervention is important. However, the development of overweight and obesity may vary between cultures. Perceptions of the obesity epidemic may differ between populations. In addition, the acceptable format and mode of delivery of interventions may vary between populations due to the different characteristics of the cultural constructs of each community. Hence, it is important to ensure the implementation of an appropriate intervention that meets the specific population needs.

Although childhood obesity has become a public health crisis in the KSA, no intervention as of yet, is available for preschool children and their families. This highlights the importance of adapting an existing and successful intervention such as Trim Tots. It is expected that a cultural adaptation of such an intervention would be helpful in reducing the financial and time burden of undertaking primary research and develop new interventions for the KSA, as well as enhancing the acceptability and efficacy of the intervention. This chapter analysed qualitative data in order to understand the maternal perception of obesity, barriers and enablers of participation in a lifestyle intervention in the KSA, as well as the challenges of adopting healthy dietary habits from the point of view of Saudi mothers.

7.2 Results

Qualitative data were collected using individual interviews with mothers of Saudi preschool children. A semi-structured questionnaire was used to guide these interviews; the methods of this have been described in Chapter 5. Thematic analysis was used to analyse such qualitative data ⁽⁷⁴³⁾. In the current

study, saturation, wherein no more new themes emerged, was reached after collecting 24 interviews. 20 mothers consented to audio-recording of the interview, while 4 did not. Therefore, in these 4 participants, the principal researcher (myself) led the discussion while the research assistant took notes and documented quotes manually. Once completed, all interviews were translated into English and transcribed into an electronic file. Thematic analysis was performed using NVIVO11 software. Figure 7-1 illustrates a summary of extracted themes, while Figure 7-2 provides more details of such extracted themes and sub-themes. Themes and subthemes were supported by quotes. Each quote is coded with the participant's ID number, which is related to the "Healthy Living Qualitative Study" (HLQS).

Figure 7-1 Summary of extracted themes and sub-themes

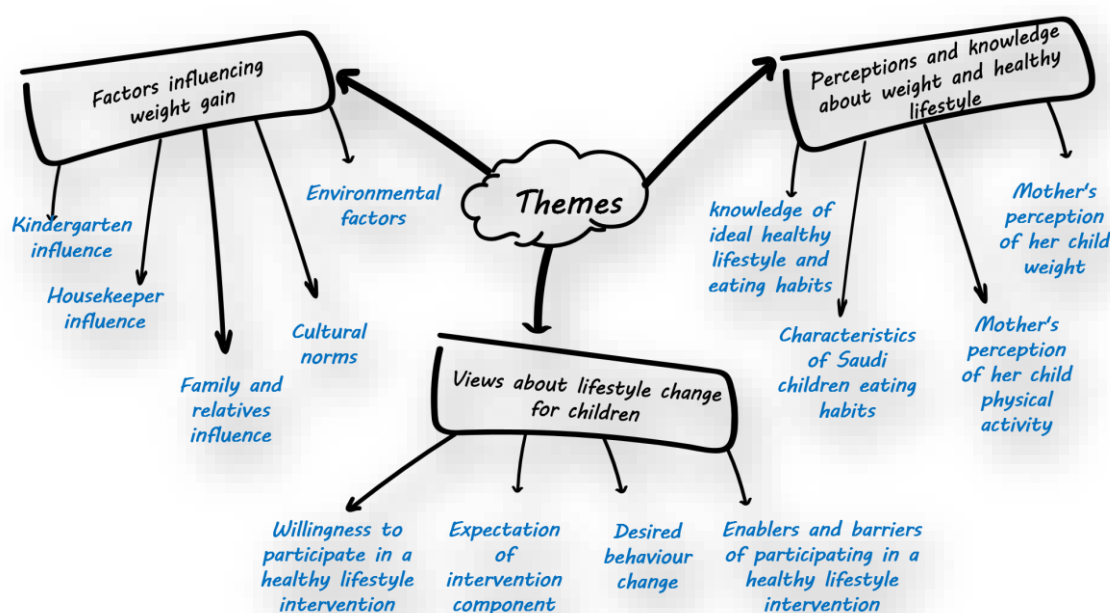
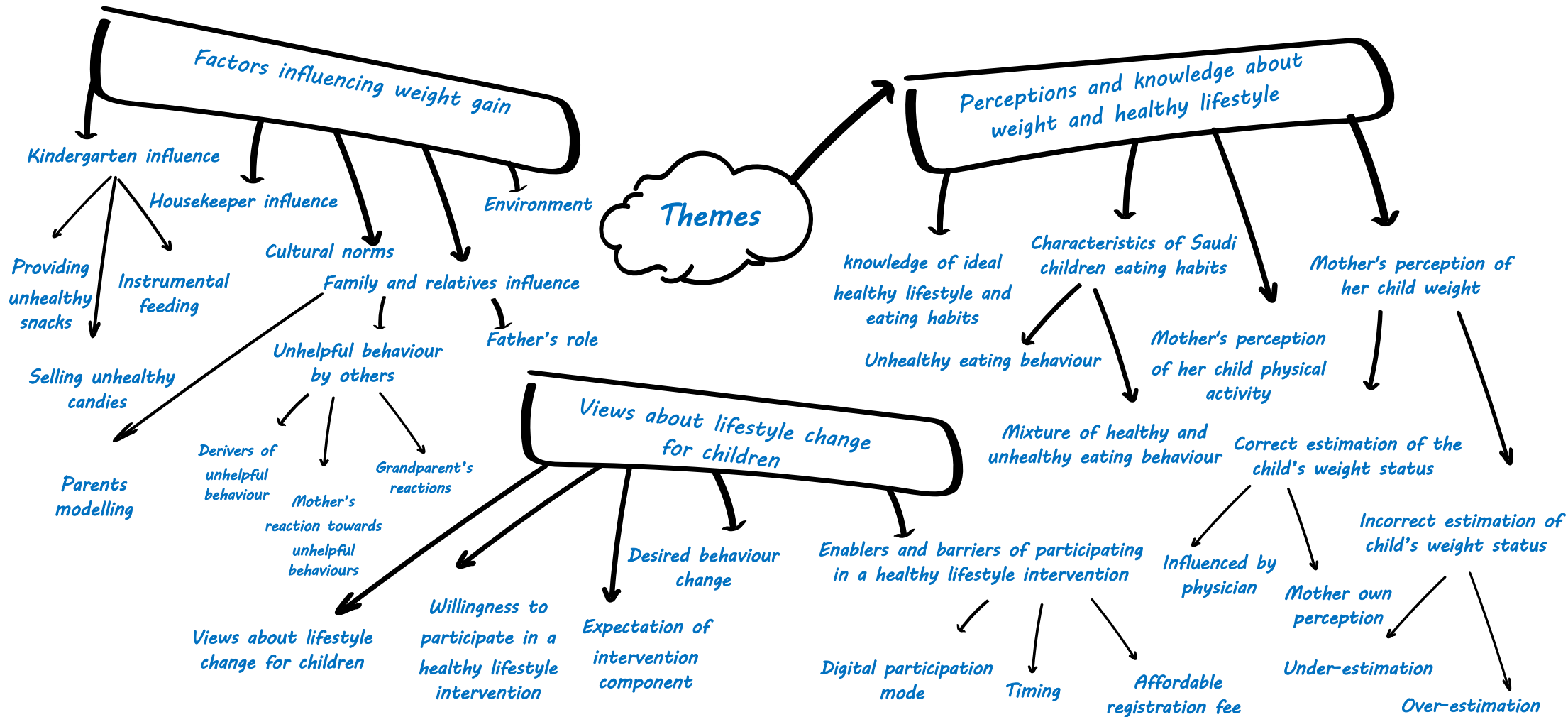


Figure 7-2 Details of extracted themes and sub-themes



7.3 Thematic analysis of the qualitative study

Overall, three main themes were identified; 1) perceptions and knowledge of weight and healthy lifestyle, 2) factors influencing weight gain and 3) views about lifestyle change for children. More details of themes and sub-themes that were supported by quotes can be found below.

7.3.1 First main theme: Perceptions and knowledge about weight and healthy lifestyle

The section below summarises the knowledge of Saudi mothers with regards to a healthy lifestyle and shows their perception of child weight status.

7.3.1.1 Mothers' knowledge of the ideal healthy lifestyle and eating habits for children

The participating mothers had a good understanding of healthy eating habits and lifestyle for children. They mentioned the importance of eating a variety of foods, and that a healthy diet should be rich in fruits and vegetables. Many mothers pointed to the importance of drinking enough water. In addition, they stated that a healthy diet should not consist of artificial food colourings and preservatives. They also pointed out the importance of not adding huge quantities of fats and oils to food. Additionally, mothers mentioned the importance of being active and sleeping well.

Quote examples:

HLQS3: "A healthy diet should include a variety of food. It also should include drinking water".

HLQS34: "Children needs routine. They need to sleep well, to eat at regular times".

HLQS5: "In my opinion, children need to sleep early in the night and to eat a variety of foods with lots of fruits and vegetables. Also, eating food rich in omega 3, like fish, is important".

HLQS7: "Healthy food should not consist of additives and colouring or lots of oil".

HLQS10: "When they eat a variety of foods, for example, fava beans, peas, egg, fish and okra".

HLQS11: "Eating healthy food and making exercise are important things".

HLQS22: "Healthy lifestyle is when we get complete nutrition and avoid fast foods and unhealthy foods".

7.3.1.2 Characteristics of Saudi children eating habits

Many of the mothers reported that their children consumed less healthy foods. For instance, it was reported that eating less healthy snacks, such as sweets, candies and chocolate, was common. Many children in the present study ate convenience (fast) foods and drink less healthy drinks such as sweetened sugar beverages. It was also reported that many children do not eat an appropriate variety of foods and have low fruit and vegetables intake. Other mothers reported a mixture of healthy and less healthy dietary habits. For instance, some children eat fruits but not vegetables. This is supported by the quotes below.

Quote examples:

HLQS10: "He eats limited foods, such as pizza, nuggets, burger, macaroni and white rice and he likes juices in general".

HLQS11: "She eats a variety of foods. She listens to me and eats whatever I tell her to eat. But my daughter's preferences are toward sweets"

HLQS12: "She eats few fruits and almost no vegetables. And she is like any other child, she eats sweets and chocolates".

HLQS16: "She eats only Nutella sandwich. Because it's chocolate. From fruits; sometimes she eats pears. But she hates banana. She is very selective".

HLQS18: "Look, he eats fruits but not all the kinds. The problem is that he almost does not eat any vegetables. Never! He never eats anything with green colour. Like lettuce and spinach and any green thing"

HLQS19: "She has good dietary habits. She eats vegetables and fruits. She does not skip breakfast. But she does not drink milk. This is the problem I am facing with her".

7.3.1.3 Mothers' views of children's weight

Many mothers reported that weight varied considerably between children, as detailed in the quotes below.

Quote examples:

HLQS2: "I think there is a great variation".

HLQS5: "There is a variation, sometimes you see thin children and sometimes you see obese children and of course you will see many healthy children in a normal weight. I think there is no specific trend regarding children's weight".

HLQS7: "Sometimes children look bigger than their actual age.
And on the other side, there are children who are underweight.
And there are children who are in the normal weight range".

7.3.1.4 Mother's perception of her own child's weight

The perception of child weight status differed between mothers. For instance, some mothers were able to correctly estimate their child's weight status, while others underestimated it. Unexpectedly, one mother overestimated her child's weight status. More details are provided below.

Correct estimation of child weight status

Some mothers were able to recognize the correct weight status of their children. The reason behind this correct estimation either was attributed to the mother's own perception or information obtained from a physician while visiting the hospital when their child became sick. Examples of quotes from mothers are given below.

Correct estimation based on mother's own perception

Quote examples:

HLQS11: "She is little a bit overweight between (=in comparison to) her friends".

HLQS18: "He is good like this".

HLQS23: "Her weight was very good until I weaned her. After that, she started to drink the "Saudi milk" and only during six months she gained too much weight".

Correct estimation influenced by physician

Quote examples:

HLQS9: "Recently, my children got sick and we visited the doctor. He told me that my son is on the borderline of becoming obese. He told me that my son is only 2 kg away from becoming obese".

HLQS 12: "She was sick and we visited a paediatrician. He told me that she is 9 kilos above the normal. And, she had to lose that weight to become healthy".

HLQS14: "We visited the doctor when she was sick. And he told me to be very careful with her weight. She is in the obesity category".

HLQS24: "We visited the physician 1 month ago, you know because of the weather change and we all got sick. The doctor warned me saying that my son's weight is above normal".

Incorrect estimation of child's weight status

Although some mothers had correctly estimated the category of their children weight status as shown previously, others did not, as indicated below.

Under-estimation of the child's weight status

Some mothers considered their children underweight, while in fact, they were in the healthy weight range. However, another mother considered her child's weight status was within the healthy range, while in fact, it lay within the overweight category.

Quote examples:

HLQS5: "I think he is thinner than he should be". (Note: In fact, the child's weight is normal).

HLQS16: "She is thin. She is slim and like a small bird". (Note: In fact, the child's weight is normal).

HLQS20: "He is normal. I do not want him to gain weight or to lose weight". (Note: In fact, the child is overweight).

Over-estimation of child weight status

Only one mother over-estimated her child weight status. She preferred that her daughter would lose some weight, while in fact, the child's weight status was within the healthy weight range. That mother of participant ID HLQS22 said:

"I prefer if her weight is lower". (Note: In fact, the child's weight is normal)

7.3.1.5 Mother's perception of her own child physical activity

Some mothers considered their children inactive, while other mothers considered them very active. Supportive quotes are provided below.

Perception of sedentary behaviour

Quote examples:

HLQS1: "He is not active, but I am planning to register him in a gym for children".

HLQS14: "She is not active at all".

Perception of physical activity

Quote examples:

HLQS15: "She is active".

HLQS16: "She is very very very active"

7.3.2 Second main theme: Factors influencing weight gain

Mothers stated many factors they believed to contribute to weight gain in children, including the influence of kindergarten, housekeepers, relatives and family members. In addition, mothers mentioned specific cultural and environmental factors in the KSA that contribute to weight gain. More details are provided below.

7.3.2.1 Kindergarten influence

It is important to mention that the sample for the present study was via children attending a private kindergarten. In this kindergarten, there was a shop that sold less healthy snacks. In addition, mothers mentioned that some meals provided by the kindergarten were less healthy. Moreover, it was reported that one staff member practiced instrumental feeding. These are clarified below.

Providing less healthy snacks at the kindergarten

Quote examples

HLQS6: "The kindergarten provides children with Nutella sandwich as a snack. They also provide them with canned juices with the main meal. If the kindergarten is providing things like this, then what would we expect children to crave for later. I really want to talk to the administration about this".

HLQS10: "And even they give chips and juice to children as a snack"

Selling candies and sweets at the cafeteria of the kindergarten

Quote examples:

HLQS2: "The kindergarten is making it very easy for children to buy biscuits and chocolates. I tried to stop giving my son money to buy those junk sweets, but then he became like the only poor desperate child and I had to give him money again".

HLQS5: "The nursery should offer children healthier meals and stopped selling the junk snacks".

HLQS6: "It sells a very bad quality of chips and sweets"

HLQS15: "She can find chips and candies and so on everywhere (in the kindergarten.....etc.)"

Instrumental feeding

Using instrumental feeding by one of the kindergarten staff was mentioned by one mother, as indicated by the quote below:

HLQS5: "Unfortunately, teachers here provide candies to children as a gift for the good behaviour".

7.3.2.2 Family and relatives' influence

The study identified a possible adverse influence either of parents or other relatives in contributing to weight gain in Saudi preschool children. For instance, it was reported that some mothers modelled less healthy dietary habits, and fathers practiced indulgent feeding behaviour. Some grandparents

were reported to hold unhelpful beliefs toward the optimum nutrition of a child. Supportive quotes are provided in the section below.

Modelling less healthy eating habits by mothers

Quote examples

HLQS12: "I should be honest. I do not cook at home. We are living on fast foods and deliveries. And I admit that our home is full of chips, chocolate and sweets. I love those snacks. I know they (=her children) are influenced by my own bad eating habits".

HLQS20: "I am obsessed with chocolates. And when he watches me eating chocolate, he comes to me and asks me for some"

HLQS8: Our eating habits, in general, are wrong. And I am the first mother to say that I am wrong. But, people surrounding me are not helping me in feeding my child a healthy diet.

Indulgent feeding behaviours practiced by father

Quote examples

HLQS17: "Even if I tried to say no, her father tells me not to say no. He says, 'do not deprive her'. He is spoiling her.

HLQS6: "The second one is my husband. I really get tired with him; he does not listen to me at all, may God direct him to the right path. Unfortunately, he is the main reason why my girl is used to eating sweets, chocolate and chips all the day. He is the main supplier of such snacks to the home".

7.3.2.3 Unhelpful behaviour by others (e.g. grandparents)

Other relatives, particularly grandparents had a role in shaping the children's dietary habits, as indicated by the quotes below.

Quote examples

HLQS1: "it is really very difficult to control his (= her son) dietary habits because he is in somehow living with my parents. He stays at my parents' house until I get back from work. My son resists me because he sees me as a monster because I am the only one who says NO! He knows that my parents (=his grandparents) will ignore my instruction and give him everything he likes to eat".

HLQS5: "My son loves his grandparents, and we visit them each weekend. And of course, during these visits they provide him with lots of sweets and candies. And I cannot do anything about it".

HLQS8: "We are living with his grandparents and they are spoiling him. They provide him with whatever he wants. And my son knows that when he wants something that I do not allow, he just can go to his grandparents and he will get it"

Drivers of unhelpful behaviour

Unhelpful feeding behaviours by grandparents were practiced with good intention. The "treasure child" was one driver of spoiling him/her. Supportive quotes are provided below.

Quote examples:

HLQS1: "Actually my parents do love him, they like to spoil him"

HLQS8: "He is the first grandchild in the whole family. He is very precious to the family and they love him so so much. The whole

family was like flying from the happiness that he was born. Of course, his grandparents and the whole family are just spoiling him".

HLQS24: "They are doing this with the best intention. They are showing their love in their way".

Mother's reaction towards unhelpful behaviours

Some mothers expressed their rules with regards to feeding their children clearly. Other mothers were shy and could not be direct. This is supported by the quotes below.

Clear position against unhelpful behaviours

Quote examples

HLQS3: "I was asking my father-in-law very kindly not to allow them to get these huge quantities of such bad sweets".

HLQS4: "I had to be polite and to find a way to refuse what she (=the grandmother of the child) did and I said, 'oh Mom, that will make our little bundle of joy suffer from gases'".

Not clear position against unhelpful behaviours

Quote examples

HLQS5: "It will be impolite. I cannot say she (= the grandmother of the child) is wrong. I do not want to turn her against me".

HLQS8: "I can't speak very directly to my family-in-law. I do not want them to misunderstand me. It is like I am disrespecting them. But I try to explain my rules indirectly".

HLQS14: "I don't want to break her heart (=the grandmother of the child). She is a very old woman. It is not nice to be teaching her. And my daughter was named on her grandmother's name. So, she got a special place in her heart. I do not want to hurt her feeling".

Grandparent's reactions

It was reported that some grandparents' attitudes to healthy eating were in conflict with parental views around healthy eating. These grandparents were controlling and did not comply with parents' rules with regard to child feeding habits. For example, these grandparents have the perception that spoiling their grandchildren is one of their rights. Other grandparents held unhelpful beliefs regarding infant and child feeding (e.g. introducing complementary feeding since the second month of life is good for health).

Quote examples

HLQS1: "I remember when I tried to take an opposite position and prevent my child from eating something unhealthy, my father yelled at me and said with a very strong tone of voice, 'your instructions are to be applied in your house but not in mine'".

HLQS3: "He (=the grandfather of the child) got mad at me and he was saying that, 'you want to take away my rights of bringing happiness to my grandchildren...' Then he started to say things at the family gathering, which made me in a very bad position. Things made me appear in the position of that bad daughter-in-law who does not respect her father-in-law".

HLQS4: " She (=the grandmother of the child) used to feed my elder and first daughter hummus, okra edam and soups when we visited them. I just got shocked while we are sitting at the dining table and she suddenly fed my daughter hummus. I had to be

polite and to find a way to refuse what she did politely and I said, 'oh mom, that will make our little bundle of joy suffer from gases'. But, she confidently said, 'NO!, children should taste everything from now so they can eat everything when they are older.' This happened while my daughter was 2 months".

HLQS8: "The problem is that no-one listens to my word. I do not have a word on my child eating habits or whatever. His grandparents will easily break my word. If I said no, his grandmother comes to me. If I said no, his grandfather comes to me"

HLQS11: "They (=the grandparents of the child) get mad, they say, 'poor children, leave them to enjoy eating what they like'".

7.3.2.4 Housekeeper influence

The influence of housekeepers was reported by one mother. who mentioned that her daughter developed a preference to "Indomie" (a brand of fried noodles) as a result of the housekeeper eating this. See the quote below:

HLQS14: "She started to develop an appetite for "Indomie" because the housekeeper eats "Indomie". So, I am trying to convince her that "Indomie" is not healthy and bad. But, she smells the odour and insist on eating some".

7.3.2.5 Environmental factors

Environmental factors, such as the hot climate in the KSA and the limited space in some flats, were reported as barriers to adopting a more active lifestyle. In addition, the media's adverse influence on children's dietary habits was reported by some parents, as indicated in the following sections.

Space at home

Quote example:

HLQS9: "They are not active. We do not have space for them to move and run and play. We do not have nice places where we can go to and they can play at".

Climate

Quote example:

HLQS9: "I tried to go with them to play in the open area on the roof. But they did not play for more than 2 minutes and they said, 'mom, it's too hot'".

Media and advertisement influence

Quote examples:

HLQS2: "Social media and the advertisements on TV are very much influencing my children's food preferences. For example, the advertising for Oreo biscuits makes my children obsessed with Oreo".

HLQS18: "Those "Moshayaa Family" (=YouTubers), they bring Indomie and eat it and then he started to ask for eating Indomie".

HLQS24: "The problem is that children like to try whatever they see on TV. The advertisement is somehow encouraging them to eat fast food, chocolate and biscuits. And add to that, some fast-food restaurants like McDonald's provide toys with their Happy Meals. Sometimes my son asks for McDonald's immediately after watching its advertisement on the TV".

HLQS24: "Do you know that my son insists on buying any biscuits or any product in the supermarket if it has a picture of Paw Patrol on it"

Cultural norms

It was reported that the construct of the Saudi Arabian culture could influence child eating habits as a result of hospitality norms. This includes providing generous amount of foods and sweets in regular gatherings. This is supported by the quotes below.

Quote examples:

HLQS2: "What makes things difficult is our culture. Even if you tried to create a healthy environment at home, you still will fail because your children are going here and there and everyone is providing them with chocolates and sweets".

HLQS7: "Because people are giving sweets wherever you go; while visiting our family, relative party, or wherever. Sweets are given as a very lovely and beautiful thing".

HLQS15: "We used to live in the USA, and I used to be able to control everything. I did never allow her (=the daughter) to eat any chips or lollipops or any unhealthy foods. But the system I conducted for her when we were in the US just broke down when we got back to Saudi. She can find chips and candies and so on everywhere, in the kindergarten, during any visit and even at home with her grandparents. I just lost control. It is very difficult to manage the situation when you are in Saudi".

7.3.3 Third main theme: Views about lifestyle change for children

This theme provided an insight into Saudi mothers' willingness to participate in a lifestyle intervention that addressed preventing childhood obesity. It also explored the barriers and enablers of participation in a lifestyle intervention conducted in the KSA and provided information with regard to the acceptable format and mode of delivery of an intervention for the Saudi population. These are presented below.

7.3.3.1 Willingness to participate in a healthy lifestyle intervention

There was agreement by mothers that it is important to conduct a healthy lifestyle programme in the KSA. They also expressed their interest to participate in such a programme.

Quote examples:

HLQS7: "It will be an excellent idea. I will be very interested as this is a very good thing for all children. If one child starts to eat healthier food then he may influence his peers and his peers may influence their peers and so on. So, I think it is going to be very good to the community in general".

HLQS12: "There is a true need for a programme such as this one".

HLQS15: "I really like the idea. And we need programmes like this, especially in Makkah".

HLQS18: "It is very good. Because I can't find a source of information that I trust. I hate finding information on Google. I do not trust the information on Google".

7.3.3.2 Expectation of intervention component

Mothers expected interventions to compose of healthy snacks, competition games, storytelling and shows, as indicated by the quotes below.

Quote examples:

HLQS4: "My daughter likes shows and theatre performances. I would want to register her in a programme that teaches children about healthy food through something like a theatre show".

HLQS5: "I think it will be very helpful to encourage children to eat healthier foods and to abandon eating junk foods by setting activities and challenges for children at the kindergarten. For example, my son likes the challenges and activities, he likes to win and so he is willing to commit to whatever it takes to win. So, it is most probably he will get motivated by such activities".

HLQS10: "Maybe eating healthy food together with his peers"

HLQS12: "I would like my daughter to eat a variety of healthy foods with her friends at the kindergarten, as I think children will encourage each other to try different things".

HLQS20: "I wish if she can eat healthy snacks with her friends daily. I wish if you can attend daily and if you can at least help the children to eat with you a healthy meal. And we can send you the component of healthy meals and you supervise the children".

HLQS8: "If you can provide us with healthy food recipes. And ideas of healthy snacks"

7.3.3.3 Desired behaviour change

Many mothers stated they wished their children would become more active and eat a variety of foods, including more fruits and vegetables, as indicated by the quotes below.

Quote examples:

HLQS1: "I want him to eat fruits and vegetables and I want him to eat yoghurt and drink milk rather than chocolate, sweets and juices".

HLQS4: "I want her to stop eating chocolate".

HLQS6: "I want her to get motivated to eat vegetables like okra, cauliflower and jew's mallow".

HLQS15: "I wish if she starts to eat fresh fruits and salads and I want her to stop eating fried foods and sweets".

HLQS21: "I hope that she stops eating macaroni, french fries and pastries. I hope she eats more vegetables"

7.3.3.4 Enablers and barriers of participating in a healthy lifestyle intervention

Many participants stated that requiring mothers' personal attendance would be a barrier to participation. This is because these mothers were either employed or had personal circumstances and commitments. However, participating online (e.g. via WhatsApp) was reported as a suitable option. Another barrier was the timing of the intervention. Conducting the intervention on weekends would be a barrier to participation for many mothers, as they have their personal commitment with their families and friends. Conversely, conducting the intervention during weekdays and while

the children were already at the kindergarten was acceptable. In addition, one mother mentioned that an affordable registration fee is an enabler of participating in an intervention. Quotes in support of these statements are presented below.

Digital participation mode

Quote examples:

HLQS1: "The most important thing to me is that I can participate without attending personally as I have a job".

HLQS3: "What might hinder me from participating is asking me to attend personally in all sessions because you know I am working in a hospital, so I cannot".

HLQS5: "I think it is very good. At the end, we all have WhatsApp. I think receiving the information on WhatsApp from my point of view is much better than getting brochures. Paper can get lost but having the information on WhatsApp makes life easier. The information is already saved there and you can go back to check them whenever you want".

HLQS10: "I just cannot attend personally because it is difficult to take many leaves from my workplace. So, it would be very much easier for me to participate if we can keep in touch via WhatsApp or another application".

HLQS21: "What may encourage me is the easy communication. I mean it is very nice that we can contact easily on WhatsApp. And I like that the meetings are once per month. Because if it was weekly, then it might be very difficult for us as mothers to commit. But once per month allows us to arrange our schedules".

HLQS24: "I support the idea of getting learning materials online. For example, it is very easy to send us the materials either using email or via WhatsApp or Telegram as well. For example, I am already participating in the "MUEIN" programme. And also, I participated in more than a course with Dr. Sumayah Al-Nasser (=online courses)".

Timing

Quote examples:

HLQS1: "And it is very important to run the programme during the weekdays as we have a full schedule during the weekends".

HLQS3: "It will be good to run the programme within the same time in which children are attending the kindergarten".

HLQS6: "Any day is okay but not the weekends. Because we have to visit our families at the weekends and we want to spend some time in getting fun as well".

HLQS12: "The time while my daughter is attending kindergarten will be good".

HLQS15: "I do not prefer weekends at all as we have a busy schedule. Her father is very busy during the weekdays, so we had to spend the weekends with him and sometimes we have cultural commitments. So, I cannot be sure that we will be able to attend during weekends".

Affordable registration fee

Quote example:

HLQS3: "In general, I would participate if the price was affordable".

7.4 Summary of findings

In summary, this study provided in-depth information to help in understanding the perception of Saudi mothers with regards to childhood obesity. It was shown that Saudi mothers, in general, had a good knowledge with regard to a healthy diet. For example, the importance of eating a balanced diet was mentioned by many mothers. However, many mothers mentioned that their children's dietary habits are less healthy (e.g. inadequate intake of fruits and vegetables as well as frequent intake of energy-dense snacks). In the present study, Saudi mothers cited many factors as barriers to adopting a healthy lifestyle. These included environmental factors such as the hot climate in Makkah region, inadequate space at home for physical activity and the role of media. Sociocultural factors were also mentioned by Saudi mothers as a barrier of adopting a healthy lifestyle. These include the hospitality norms of the Saudi population and the indulgent feeding behaviour practiced by grandparents with good intentions.

The current study found that participating mothers agreed with the importance of conducting a lifestyle intervention in the KSA. These mothers showed a willingness and interest to participate in such an intervention. However, mothers' personal attendance at 12 sessions was a barrier to participation, especially for those committed to a full-time job. Conversely, the online mode of delivery for the mothers' component of the intervention was acceptable. With regard to the child component of an intervention, appropriate timing was an enabler for mothers to register their children's participation. For instance, it was reported that conducting the intervention during weekends may not be suitable because many family gatherings take place then. This may hinder child adherence to an intervention. However, conducting the child component of the intervention during weekdays whilst they attended the kindergarten appeared to be suitable option.

7.5 Discussion

Possible barriers to adopting a healthy lifestyle in the KSA were investigated by the current study. As well, potential enablers and barriers to participation in healthy lifestyle interventions for the Saudi population were reported here. The findings of the present study are discussed in the following sections.

The role of climate in children's lifestyle

The hot climate in the KSA was reported as a barrier to being physically active in the present study. This is a concern, as it is well documented in the literature that low levels of physical activity are a risk factor for obesity development⁽²⁸⁷⁾. The findings of the present study are in line with those of a review that included 158 studies investigating the influences of the natural environment on physical activity and sedentary behaviours of preschool children. This review confirmed that the natural environment can present barriers to physical activity⁽⁸⁶³⁾.

Another supportive example includes the finding of an earlier qualitative study that included 51 Latino mothers. It was reported that these mothers also considered climate to be a barrier to physical activity. For these mothers, cold climate was associated with less time spent in physical activity⁽⁸⁶⁴⁾. In support of this, a study in 85 preschool children (3-4 years) living in Ireland found that the number of steps taken daily was 20% less during the winter season than during the spring⁽⁸⁶⁵⁾. Extremes of temperature (i.e. too hot or too cold climate) are barriers to physical activity and differ across countries. Thus, interventions may need to consider targeting indoor physical activity. However, a recent study conducted by Parrish et al. (2022)⁽²⁹⁶⁾ in the US looked at the indoor physical activity of preschool children and reported that many caregivers face difficulties in accommodating physical activity at home. This, for instance, was attributed to the limited availability of domestic space. Additionally, physical activity at home was described as troubling and uncomfortable by some caregivers. Hence, policymakers may wish to consider establishing indoor recreation structures designed for children's active play in public spaces, such as shopping malls. Further investigations are recommended with regard to

increasing indoor physical activity in preschool children. This may include considering encouraging minimal and structured physical activity at home, such as using online videos to guide home exercises in limited space.

In addition, providing children with informal care was also suggested to influence the risk of obesity in the present study. This is discussed below.

The role of providing informal childcare in children's food intake

Associations between increased risk of childhood overweight/obesity and informal care (i.e. by grandparents or domestic helpers) were reported previously in the risk factors study (Chapter 6). The findings of the present qualitative study may help clarify these associations. It was reported that grandparents practiced overindulgent feeding behaviours with their grandchildren. For instance, the mother of participant ID HLQS1 described how her parents spoiled her child, a process that adversely influenced her son's dietary habits. She said:

“He stays at my parents’ house until I get back from work. My son resists me because he sees me as a monster because I am the only one who says no! He knows that my parents (=his grandparents) will ignore what I tell them and give him everything he likes to eat”.

Additionally, the mother of participant ID HLQS8 said:

“We are living with his grandparents and they are spoiling him. They provide him with whatever he wants. And my son knows that when he wants something that I do not allow it, he just can go to his grandparents and he will get it”.

These findings were in line with a recent qualitative study of 40 participants in New Zealand. The study reported that some grandparents used indulgent feeding behaviour, since they considered the time spent alone with their grandchildren to be a time for treats. An example of treats provided by grandparents included sweets, ice cream, cakes and pizza ⁽⁸⁶⁶⁾. Consistent

findings were also reported in a qualitative study from a focus group of 14 parents. The parents perceived that frequent snacks provided by grandparents could help explain the development of overweight in their children ⁽⁸⁶⁷⁾. There might be several explanations for the unhelpful practices of informal carers, as discussed below.

Potential drivers of unhelpful practices by informal carers

Beliefs may play a vital role in driving such unhelpful behaviours. For instance, in the present study, one of the participating mothers mentioned that her mother-in-law believed the early introduction of complementary feeding was good for the child (Participant ID HLQS4). Even when the mother tried to change the grandmother's opinion, she insisted that children should taste everything early (since the second month of life) to enable them to eat everything when they are older. This is in line with the findings of a qualitative study conducted by Lidgate and Li (2018), which reported that grandparents often had their own set of unhelpful beliefs and opinions that were outdated and did not comply with current recommendations on infant milk feeding or on the introduction of complementary foods ⁽⁸⁶⁷⁾. Another consistent example includes the findings of a study in 267 Hispanic toddlers. This study reported that the presence of a co-resident grandparent was associated with a more than a 3-fold higher risk of adding cereals to infant milk bottles ⁽⁴⁰⁰⁾. This is considered an inappropriate feeding behaviour, which may contribute to developing childhood overweight/obesity via providing more energy than needed ⁽⁸⁶⁸⁾.

Some parents in the current study found it difficult to make suggestions to grandparents regarding infant feeding as this might be perceived as disrespectful behaviour. For example, the mother of participant ID HLQS8 said:

"I cannot speak very directly to my family-in-law. I do not want them to misunderstand me. It is like I am disrespecting them. But I try to explain my rules indirectly".

Another mother, the mother of participant ID HLQS5, believed that it was impolite to complain about the grandmother's feeding practices. She said:

"It would be rude. I cannot say she is wrong because I do not want to turn her against me".

The mother of participant ID HLQS14 described providing the grandmother with suggestions as heart-breaking. She said:

"I do not want to break her heart. She is a very old woman. It is not nice to teach her".

These findings are consistent with those of a qualitative study conducted in the UK. The study involved 4 focus groups and reported that providing suggestions to grandparents with regard to child feeding might be perceived as an insult or an accusation that parents do not trust grandparents in terms of child feeding⁽⁸⁶⁷⁾. The present study findings also are in accordance with a recent qualitative study conducted in the KSA in 2020. This study referred to traditional large family gatherings as one of the major constructs of Saudi society. In such gatherings, energy-dense food is provided in abundance. It was also reported that many mothers said they accepted inappropriate feeding by other relatives at such gatherings to maintain peace and harmony between family members⁽³⁹⁵⁾.

According to the findings of the present qualitative study, some parents expressed their wishes concerning child feeding to the grandparents. However, some grandparents refused to agree. This was illustrated by the reaction of a grandfather who believed that the child's mother was taking away his right to bring happiness to his grandchildren by asking him not to allow them to buy huge quantities of sweets from the supermarket. The mother of participant ID HLQS3 said:

"I was asking my father-in-law very kindly not allow them to get these huge quantities of bad sweets. He got mad at me and he was

saying, 'you want to take away my rights of bringing happiness to my grandchildren'".

Claiming the right to spoil grandchildren is in agreement with the findings of a recent qualitative study conducted in the US, which included 14 focus groups. The study reported that some grandparents claimed the right to spoil their grandchildren with treats such as sweets and chocolate, since the parents' role involved primary (i.e. core) food preparation ⁽⁸⁶⁹⁾. Another consistent finding was reported by a qualitative study conducted in the US that interviewed 22 parents of preschool children (from 27 grandparents). This study reported that, although grandparents identified less healthy foods correctly, many of them believed that they held certain privileges and perceived that indulging grandchildren was part of the grandparental role ⁽⁸⁷⁰⁾.

Grandparents' responses to parents' wishes concerning child feeding behaviours differs between cultures. For example, the qualitative study conducted by Lidgate and Li (2018) ⁽⁸⁶⁷⁾ reported that English grandmothers appear to be more respectful of the mother's food choices for her child than Dutch grandmothers. A quote in support of this was reported by a mother who said:

"Do you know what that's quite interesting! My mum is not English, no my mum is Dutch and they are very forthright people and she is less respectful of my opinions than my mother-in law who is English".

Another study that examined the South Asian communities living in the UK reported that in these ethnic groups, grandmothers, in particular, are held in high regard and can take control over the children's diet ⁽³⁹⁸⁾. Likewise, in Hispanic cultures, where living within an extended family is prevalent, grandmothers have a pronounced influence on child feeding ⁽⁸⁷¹⁾. There are also many reports from Chinese parents who find it difficult to reject their parents' beliefs and attitudes toward children's feeding practices ⁽³⁹⁶⁾. Taken together, these reports suggest that the cultural construct of some

communities provides grandparents with authority over child feeding practices. This may explain the association between childhood obesity and informal care provided by grandparents. The common perception of being underweight (rather than overweight) as a problem in extended families within specific societies could be another possible explanation ⁽⁸⁶²⁾. Another study conducted in the US reported that many caregivers of young children perceive obesity as a problem only in adulthood, but not during preschool years ⁽⁸⁷²⁾.

Further factors could influence caregiver's (grandparents or domestic helpers) practices on feeding children. This includes the perceptions of caregivers, which might be reflected in the children's dietary habits. For instance, a high level of consumption of fast food was observed in children of caregivers who considered fast-food shopping to be an easier option ⁽⁸⁷³⁾. It is also important to note that grandparents who lived in a period when food resources were much scarcer are likely to hold the belief that "bigger is better". This might explain why they overfeed their grandchildren ⁽³⁹⁸⁾.

Similarly, the belief that being overweight is a marker of wealth and good health may be held by domestic helpers who have experienced periods of deprivation ⁽⁸⁷⁴⁾. In addition, one study reported that domestic helpers involved in child feeding applied instrumental feeding practices that could adversely affect children's eating habits and weight status ⁽⁸⁷⁵⁾. This is supported by previous research which reported that instrumental feeding could be associated with a higher probability of developing childhood overweight/obesity ⁽²⁵⁸⁻²⁶¹⁾. Such factors could adversely influence child feeding practices when informal care is provided by domestic helpers.

Although hiring domestic helpers has increased in the KSA over the past decade ⁽⁸⁷⁶⁾, studies investigating the association of childhood overweight/obesity with care by domestic helpers are scarce. One study conducted in Kuwait, a neighbouring country to the KSA, included 3,473 preschool children and reported that the presence of domestic helpers was associated with ≈ 1.6 times higher risk of developing overweight in these children ⁽⁸⁷⁷⁾.

The present study suggested that domestic helper's dietary habits may influence those of children. For example, the mother of participant HLQS14 mentioned that her daughter liked to mimic the domestic helpers by eating the same food. The mother said:

"She started to develop an appetite for "Indomie" (fried noodles) because the housekeeper eats "Indomie". So, I am trying to convince her that "Indomie" is not healthy and bad. But she smells the odour and insists on eating some" (participant ID HLQS14).

This was in line with findings of a recent qualitative study conducted in the KSA, which included 20 mothers of overweight or obese school-aged children. The study shed light on the role of domestic helpers in influencing children's dietary intake. It was reported that domestic helpers tend to provide children with what they prefer, regardless of nutritional value. Additionally, it was also reported that some children like to share the domestic helper's meals, which may not be healthy. For instance, one of the participating mothers in that study said:

"My daughter loves my helper's kind of food. She eats it at least twice a week—Friday and Saturday mornings. I really don't like for her to eat this because it's all deep-fried with pasta, soy sauce, and fish sauce. It is a very sensitive subject... the helper likes to have someone to eat with so she feeds her. This is a big problem because she eats our food too. The helper feels she is being nice and it would hurt the helper's feelings to tell her to stop feeding her. She will take it very personally" ⁽³⁹⁵⁾.

A study by Sobko et al. (2017) suggested that long-term childcare provided by domestic helpers may lead to the perception of domestic helpers by the children as role models ⁽⁸⁷⁵⁾. It is therefore quite possible that they play a role in influencing food acceptance and dietary patterns in young children. Therefore, it could be helpful to provide caregivers and domestic helpers with adequate training regarding child feeding practices. Bell, Perry and Prichard

(2018) reported that one innovative strategy for childhood obesity prevention is to focus on the role of grandparents in the development of lifestyle interventions in preschool children⁽⁸⁷⁸⁾. One potential intervention could be to provide carers and grandparents with healthy snack suggestions and tips on increasing the level of physical activity in children⁽⁸⁶⁷⁾.

In brief, the role of informal care could contribute to shaping eating behaviours in young children. Different mechanisms are suggested that may help explain the adverse influence of informal care and the risk of developing childhood overweight/obesity. These include indulgent feeding behaviours where children are allowed to consume unlimited quantities of sweets. However, the role of informal care provided either by relatives or domestic helpers in the KSA is seldom investigated. It is therefore recommended that more research is conducted into the role of informal care in shaping children's dietary habits. By gaining a thorough understanding of informal care, it would be of great help in designing appropriate interventions.

In addition to the factors mentioned above, the present study suggests that the use of media plays a major role in shaping the dietary habits of Saudi preschool children, as described below.

The role of media in influencing children's food intake

The present study reported that media has an influence on children's food preferences via TV advertisements, using cartoon characters on food packaging and providing gifts with fast food meals. Furthermore, the present qualitative study suggests that celebrities may have a strong influence on child food preferences. For instance, one mother mentioned that her son's dietary habits were affected by the dietary habits of famous Saudi children (Moshayaa family) with YouTube channels boasting more than 20 million subscribers. This mother reported that her child started to develop an appetite for Indomie (fried noodles) because he was influenced by the videos posted by "Moshayaa family". These videos use children to encourage and model the enjoyment of eating such fried noodles through their online YouTube channel. This is in line

with the literature, which documents the influence of media on shaping children's dietary habits ^(323-324, 879-880). It is likely that the media influences children's dietary habits through affecting their food choices ⁽³¹⁹⁾.

Studies documenting the impact of food marketing on the dietary intake of children in the KSA are scarce. However, in 1993, Yavas and Abdul-Gader conducted a study to investigate the effects of TV commercials on the purchasing behaviour of Saudi schoolchildren. The study found that around 40% of Saudi children are exposed to a minimum of 4 commercial breaks every night, and that the most popular advertisements were for food, followed by adverts for soft drinks and toys. Two-thirds of children preferred advertisements that used animated characters. One high profile product is Afia, Saudi Arabia's leading cooking oil. Children enjoyed the advertisement in which the oil and fried food items, such as potatoes and fish, jump from the frying pan and start dancing together. As expected, a considerable proportion of children wanted to buy the advertised food items and 44% of parents consented to such a request ⁽⁸⁸¹⁾.

No studies have so far investigated the influence of the media and food advertising on the food preferences of preschool children in the KSA. It is therefore recommended that research should be undertaken to evaluate the time spent watching TV and to investigate the most prevalent channels that Saudi preschool children watch, as well as examining the contents of these channels. This is an important initial step in allowing further investigation of the content that preschool children are exposed to including any advertisements. In this way, a broader insight into the factors that affect children's behaviour can be gained. More specifically, healthcare professionals will be able to address the influence of media on developing dietary preferences in children, and subsequently, appropriate action can be taken accordingly to manage and prevent obesity during preschool years. In addition to the role of media, the kindergarten has an influence as discussed below.

The role of the private kindergarten in influencing children's diet

According to the present study, the kindergarten environment seems to play a major role in raising the risk of developing childhood overweight/obesity. This might occur, firstly by providing less healthy meals and snacks, and secondly, by selling energy-dense foods (e.g. chocolate and sweets) at the kindergarten cafeteria and thirdly through inappropriate feeding practices (e.g. instrumental feeding) by staff.

Providing less healthy meals and snacks in the kindergarten was reported by participating mothers. Such less healthy meals/snacks included providing children with chips, juice and chocolate sandwiches. For instance, the mother of participant's ID HLQS10 said:

“They give chips and juice to children for a snack”

Another mother, the mother of participant ID HLQS6, was unsatisfied with the quality of foods provided to children during mealtime in the kindergarten. She said:

“The kindergarten provides children with Nutella sandwiches as a snack. They also provide them with canned juices with their main meal. If the kindergarten is providing things like this, then what else can we expect children to crave for later? I really want to talk to the administration about this”.

As well as providing less healthy snacks in the kindergarten, facilitating the accessibility to purchase competitive foods was another factor reported in the current study which could result in weight gain in children. The mother of participant ID HLQS2 said:

“The kindergarten makes it very easy for children to buy biscuits and chocolate. I tried to stop giving my son money to buy those sweets but then he became like the only poor desperate child and I had to give him money again”.

Another mother, the mother of participant ID HLQS6, was unsatisfied with the sales of the cafeteria. She said:

“it sells very bad quality chips and sweets”,

These findings are in line with previous literature, which pointed out that some kindergartens and schools may provide children with an obesogenic environment. For example, a study conducted in the city of Makkah, reported that the food sold to Saudi children in schools includes juices, chocolate, sweets and fried chips. Meanwhile, it was noted that fruits and vegetables were not served in these canteens ⁽⁸⁸²⁾. Another study reported that 87% of the items available in Saudi school cafeterias were high in sugar and fat. These included chocolate, sweets, ice-cream fruit syrup, jellies, flavoured or sweetened milk and puddings ⁽⁸⁸³⁾.

Selling less healthy food items to children is not only a problem in the KSA, but is also prevalent in other countries. For instance, a study was carried out as part of a site visit inspection of 16 primary school canteens to analyse food sold to Malaysian schoolchildren. The study reported that school canteens offered a variety of less healthy foods such as chocolate, ice-cream, creamy and sugar-coated foods with limited availability of fruits and vegetables ⁽⁸⁸⁴⁾. Similarly, in Brazil, school cafeterias sell less healthy food, such as soft drinks and sweets ⁽⁸⁸⁵⁾.

There is a dearth of studies investigating associations between children's weight status and the childcare environment in the KSA ⁽⁸⁸⁶⁾. However, it is suggested that energy-dense foods sold to children in school cafeterias could be a determinant of childhood obesity in developing countries. The increased purchasing power of pocket money possibly exacerbates the problem ⁽⁸⁸⁷⁾. A narrative review of longitudinal studies addressed the relationship between attending a childcare centre and the risk of developing childhood overweight/obesity, reported mixed findings. However, the author proposed that the positive association of increased exposure to childcare and greater

proportions of obesity could be attributed to the obesogenic environment of kindergartens or schools ⁽⁸⁸⁸⁾.

An example of consistency with the present research findings includes the results of a study that included 820 preschool children from 8 kindergartens. This study reported that, when compared to attending public preschools, private preschools were associated with a higher risk of developing overweight and obesity in Saudi preschool children. That is, the prevalence of overweight/obesity was doubled for children in private kindergartens compared to that of children attending public ones (30% vs 14%, $p < 0.001$) ⁽⁴¹⁶⁾. In line with this, a study of 543 Ghanaian schoolchildren, attending 14 primary schools reported that attending private schools was associated positively with children's BMI. The availability of a shop that sells sweets or processed foods increased the risk of childhood obesity by 5-fold ⁽⁴⁴¹⁾.

Unfortunately, the KSA and other Arab Gulf countries lack policies that regulate the availability of healthy foods and restrict the prevalence of less healthy foods ⁽⁴⁵²⁾. It might be helpful to encourage healthy eating through the means of legislation. This includes the promotion of nutrition education, the provision of healthy foods and reducing the availability of less healthy foods ⁽⁴⁵³⁾. The adoption of such strategies is expected to result in a reduction in childhood obesity. For example, it has been shown that providing healthier food options to school children, along with improving physical education, were found to be associated with a reduction in BMI of children with overweight ⁽⁸⁸⁹⁾. It is therefore important for the KSA to set appropriate regulations in kindergartens that aim to improve Saudi preschool children's health and reduce the risk of excessive weight gain in preschool children.

According to the current study, an additional factor that may contribute to overweight and obesity is the lack of adequate nutritional training for the kindergarten staff. Instrumental feeding was reported to be practiced by at least one staff member. A quote in support of this was reported by the mother of participant ID HLQS5, who said:

"Teachers here provide candies to children as a gift for the good behaviour".

Additionally, through my personal interaction with mothers who were not participants in the study, I noted concerns from some mothers regarding sugar rush and hyperactivity due to children receiving large quantities of sweets. One mother complained that the kindergarten provided sweets for celebrations such as during the KSA's National Day. She suggested that children should be given toys rather than sweets.

The present study findings support the influential role of teachers in shaping children's dietary habits. This is in line with many previous studies that have reported rewarding schoolchildren's good behaviour or performance with energy dense foods ⁽⁸⁹⁰⁾. A qualitative study in Jeddah also reported unhelpful practices by staff. This study reported that, although teachers ate their meals alongside preschool Saudi children, they ate different food and followed a less healthy diet in front of the children ⁽⁸⁹¹⁾. Another qualitative study in Korea emphasized the role of teachers in encouraging children's eating habits. A representative quote from that study stated:

"There is a huge difference between teachers. There are some teachers who are very good at teaching the kids about eating habits....But then, things change when they are assigned to another teacher in the next grade" ⁽⁸⁹²⁾.

Another Korean mother said:

"A child's eating habits can change six times a day depending on who the teacher is. If the teacher has an awareness of good eating habits, he/she thoroughly manages the kids. Otherwise, the children can be neglected again and left to eat whatever they want" ⁽⁸⁹²⁾.

The influential role of teachers on children's dietary habits may be dependent on their own nutritional knowledge ⁽⁸⁹³⁾. A recent study conducted in New

Zealand to evaluate the nutritional knowledge of teachers of preschool children reported that limited nutritional knowledge was associated with the lack of staff training ⁽⁸⁹⁴⁾. In agreement with this, a study of 222 teachers across 80 kindergartens in China reported that only 38.7% of these teachers had attended paediatric nutrition knowledge courses or training ⁽⁸⁹⁵⁾. This highlights the importance of providing teachers with adequate training to improve their dietary knowledge, resulting in a favourable influence on children's dietary habits ⁽⁸⁹⁶⁾.

The previous section discussed the barriers of adopting a healthy lifestyle and eating habits in the KSA. The coming section focuses on discussing possible enablers and barriers to participation in a lifestyle intervention conducted in the KSA, according to the participating mothers' opinions.

Enablers and barriers of participation in a healthy lifestyle intervention

With regard to the parental component of the intervention, many mothers reported that it would be difficult for them to attend the sessions personally due to their commitments (i.e. full-time job). This is in line with previous studies. For instance, a lifestyle intervention that targeted preschool children and their families was not effective in addressing obesity because adherence to the intervention by parents who have a full time job was low ⁽⁶³⁹⁾. This highlights the importance of designing interventions that provide flexibility for parents to engage in lifestyle interventions. Incorporating technology in delivering interventions could be an effective suggestion to reach parents with busy schedules.

According to the present qualitative study, participating mothers were receptive to the concept of digitalising the parental component of the intervention. Thus, the online delivery for the parental component of an intervention could be an enabler of participation. This is supported by the findings of a systematic review, which identified 3 qualitative studies investigating users' experience of digital intervention. According to these studies, parents of young children reported that technology had become

integrated into their daily lives, which in turn, increased their acceptance of digital interventions ⁽⁵⁴⁷⁾. Another systematic review, which included 11 RCTs and quasi-experiments (with > half of included studies were of moderate to high quality), supported the acceptability of digitalised interventions. This review reported that smartphone apps and social media were considered a feasible and acceptable mode of intervention delivery. More specifically, the interactive features of such platforms that facilitate communications were favoured by participants across many studies ⁽⁶⁴⁸⁾. It is expected that social media could serve as a helpful tool that allows participants to share experiences, gain social support and learn from each other ⁽⁶⁵⁵⁾.

An example of an acceptable digital platform for intervention delivery that provides interactive features includes WhatsApp (Facebook, Inc.) ⁽⁸⁹⁷⁾. In 2021, WhatsApp was the application with the highest number of users in Saudi Arabia. WhatsApp is used by approximately 80% of the KSA population (28.4 million users) ⁽⁸⁹⁸⁾. Thus, there is a growing interest in using WhatsApp as a platform for delivering interventions in the KSA ⁽⁸⁹⁹⁾. For instance, WhatsApp was used to promote physical activity among Saudi college students ⁽⁹⁰⁰⁾. Additionally, it was used as a platform for raising knowledge about type 2 diabetes mellitus ⁽⁹⁰¹⁾ and for delivering diabetes preventative interventions that targeted the Saudi population ⁽⁹⁰²⁾. Moreover, WhatsApp was used to deliver interventions that targeted parents of Saudi children with autism ⁽⁶⁵⁴⁾.

Although WhatsApp appeared to be a suitable platform for an intervention delivery in the KSA, there is not an intervention yet that has employed it to deliver a lifestyle intervention that aims to reduce obesity rates in Saudi preschool children and their families. Therefore, the present PhD project aimed to fill in this gap by using WhatsApp as a tool to deliver the parental component of lifestyle intervention. WhatsApp can be used to educate mothers about paediatric nutrition and provide them with behaviour change techniques.

7.6 Chapter summary

The previous chapter (Chapter 6) provided information on the determinants of overweight/obesity in Saudi preschool children via a quantitative cross-sectional study. This chapter shed light on additional risk factors of excess weight gain in preschool children that are specific to the Makkah region of the KSA. This was achieved via collecting qualitative data through individual interviews with mothers. These risk factors included the impact of the hot climate, the role of grandparents, the media influence and the obesogenic environment of private kindergarten. Such information could be helpful to inform the development of appropriate interventions and could be useful for policymakers who produce guidance and regulations that support child health.

This chapter also explored enablers and barriers to participation in a healthy lifestyle intervention for the Saudi population. This was important to inform the appropriate design (format and mode of delivery) of an intervention that is acceptable for such a population. It was suggested that implementing a lifestyle intervention during weekends might be a barrier to participation as family gatherings often take place during this time. Another important barrier to participation was requiring parents with full-time jobs to attend the sessions of the intervention personally. Conversely, using the digital mode of intervention delivery appeared to be acceptable for delivering the parental component of an intervention. More information with regards to developing and adapting lifestyle intervention that suits the characteristics of the Saudi community is provided in the next chapter (Chapter 8).

8. Chapter 8: Study 3: Cultural Adaptation of the Trim Tots Healthy Lifestyle Programme for Pre-school Children

8.1 Introduction

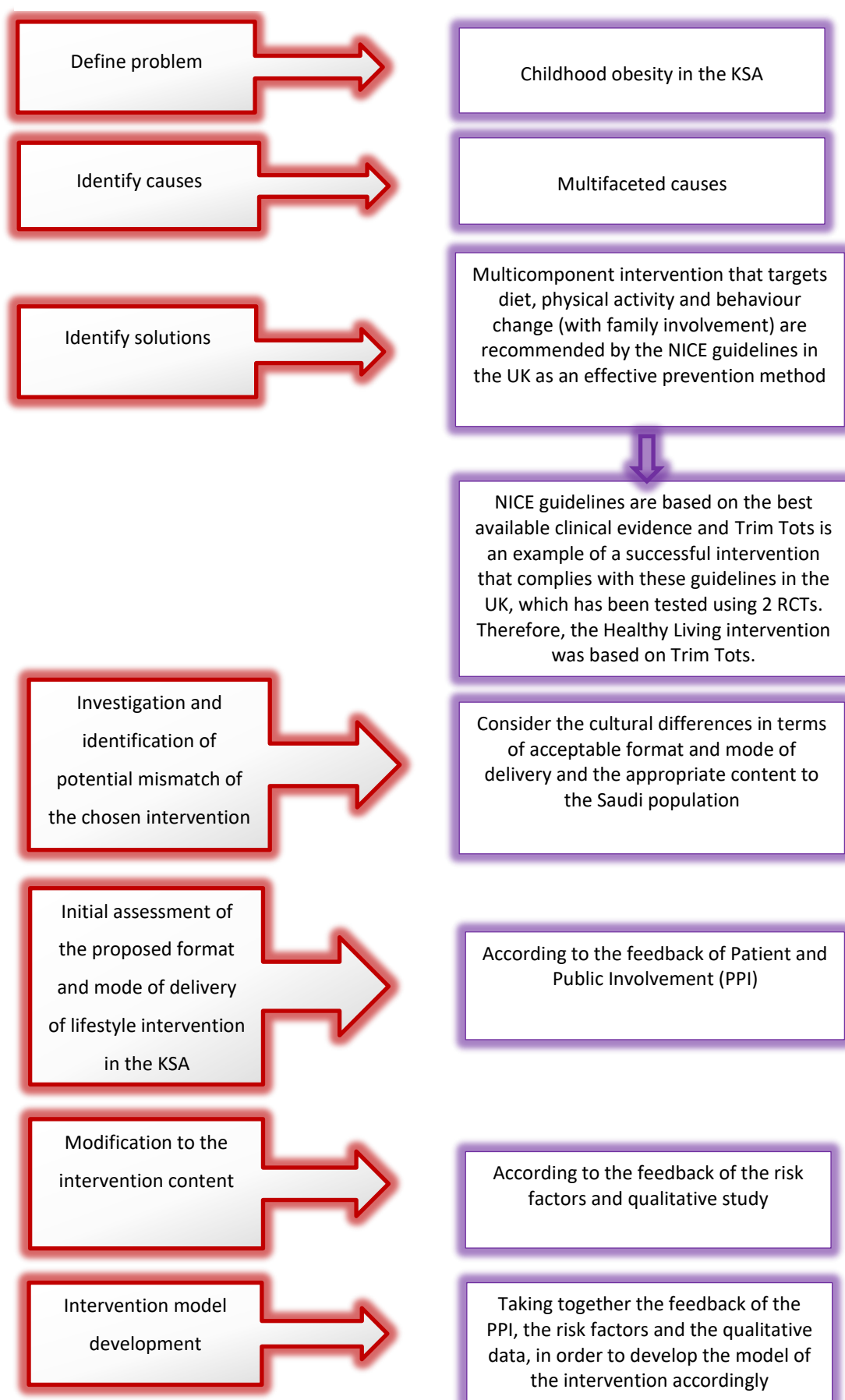
Childhood obesity rates are globally high and still increasing in many countries around the world. Thus, effective strategies are needed for prevention. Multi-component interventions, which target lifestyle behaviours most strongly associated with the development of obesity, are one strategy that has shown success in reducing risk. According to the available evidence, interventions that target young children (at preschool age) and their families with health behaviour change strategies are effective ⁽⁴⁷⁶⁾. However, few programmes exist, and more changes are urgently needed.

The Trim Tots healthy lifestyle programme for preschool children and families is one example of a successful intervention for obesity prevention. The Trim Tots programme was developed in the UK, and is the only intervention conducted in a childcare setting with evidence from randomised controlled trials to show that it is effective at reducing obesity risk ⁽⁵⁸⁸⁾. However, in the KSA, as yet there is no intervention for the prevention of preschool obesity. Therefore, the purpose of this study was to adapt the Trim Tots intervention to be appropriate for the Saudi Arabian population.

Adaptation of an existing intervention is needed for implementation in different countries and it is necessary to evaluate the feasibility of the intervention in that country. The ultimate aim is to determine whether the adapted intervention can be used in the country and replicate the effects of the original intervention ⁽⁷⁰⁸⁾. For any intervention to succeed, it should be developed according to the specific community needs and use methods that are acceptable to and accessible by the local population ⁽⁷⁰³⁾. Stirman et al. (2013) identified two important stages for appropriate cultural adaptation of an intervention. These involved modifications to the intervention, such as an appropriate format and delivery method, as well as modification to the content of the intervention ⁽⁷⁰⁹⁾.

The process of adaptation in this study went through two main stages. The first stage included patient and public involvement (PPI) to inform modification of the intervention format and mode of delivery. The second stage of intervention adaptation aimed to tailor the contents of the intervention to make it culturally appropriate and acceptable to participants. Adaptations were carried out according to the feedback from my previous studies (risk factors and qualitative research in Chapters 6 and 7 respectively). Figure 8-1 illustrates the intervention cultural adaptation process, and further details of the adaptation process are provided in the following sections.

Figure 8-1 The process of cultural adaptation of the Trim Tots intervention



8.2 First stage of the intervention cultural adaptation process

The first stage of the intervention adaptation process focused on identifying an appropriate format and mode of delivery that was feasible and acceptable to the Saudi Arabian community.

Patient and public involvement (PPI)

The UK Policy Framework for Health and Social Care advises that patient and public involvement is important and should be carried out to identify, prioritise and assist in the design of research before it is applied. It is stated that: ('the activity of involving patients, service users or the public in the design, management, conduct or dissemination of research should not be managed as though it is research in its own right'). More information can be found at: www.invo.org.uk. Therefore, prior to developing the intervention, a scoping exercise was carried out to consult the local population to investigate the format and delivery mode that would be most acceptable.

A visit to Saudi Arabia

I carried out a pre-study visit to Saudi Arabia between January and February 2018. The purpose of the visit was to gather essential information that would help inform the design of a culturally tailored intervention that would be acceptable to the Saudi population. In addition, this pre-study visit aimed to assess the feasibility and organize the logistics of the planned study. This included seeking permission from relevant authorities, as well as identification of a suitable study venue. The main outcomes of the visit are listed below.

Feasibility and logistics:

- Permission was obtained from the director of the Clinical Nutrition Department and the Dean of the Medical Sciences College at Umm-Al-Qura University to access information on kindergartens.
- Recommendations were forwarded to the Ministry of Education in Saudi Arabia and permission was issued by the Planning and Development Department of the Ministry for me to make direct contact with

kindergarten heads to access information (permission number: 39180365853).

- I identified and set up a collaboration with “Hadeekat Al Tefl” Kindergarten. This kindergarten has an adequate number of children, and suitable facilities to accommodate the project (i.e. space for children’s sessions and an area for physical activity). Accordingly, a statement confirming its participation in the project was obtained.

Assessing the suitability of the intervention design for Saudi mothers:

I met with 20 mothers, 12 of whom attended a discussion group in the kindergarten, while 8 were interviewed at a local mosque. The discussion aimed to gain an overview of mothers’ perceptions of childhood obesity and their willingness to participate in an obesity prevention programme. Mothers were asked about concerns they may have relating to the intervention, possible barriers to participation and what might be a suitable intervention-delivery method. Questionnaires used in the initial semi-structured interview can be found in Appendix I. The key findings of those discussions were:

- All mothers stated that they would be happy for their children to take part in a nutrition education programme at the kindergarten.
- Many mothers stressed that they would prefer the programme to run during working hours on weekdays. Mothers did not prefer weekends due to cultural commitments with their extended families. For example, many nuclear families visit the husband’s relatives on one day and the wife’s relatives on another day of the weekend. The third day of the weekend was kept free to have fun. Schedules were very busy and the likelihood of mothers committing to attend 12 weekly sessions was low.
- Working mothers stated that it would be very difficult for them to attend intervention sessions personally with their children. However, many of them said they would appreciate receiving the educational materials online.

- All mothers stated that the most acceptable delivery method for them was WhatsApp. For example, many mothers stated that they used WhatsApp daily, and that it would be very convenient for them to receive information this way. Others found this method to be a good use of time and said that they had previously taken part in courses delivered by professionals over WhatsApp. Time, flexibility, and the fact that the materials could be saved and accessed at any time on their phones were other reasons stated for preferring this application.
- Mothers were asked about participating in a weekly video call over 3 months. However, only a few mothers expressed an interest in this. Some mothers said they would not be interested in this option because the video call would impose a burden on them, as they would have to be up, dressed and ready to receive the call. Others said that they could not commit to a weekly video call as they have a busy schedule. Those mothers suggested that: 1) having the subject materials in the written form or a recorded video that could be sent via WhatsApp on their phones would allow more flexibility, 2) once-a-month video calls or discussion groups at the kindergarten might be possible.

The final design of intervention format and mode of delivery

The findings of this scoping visit suggested that it would be possible to develop an intervention for the prevention of obesity in Saudi Arabia using the methods above and bearing in mind cultural considerations. This included delivering the children's component of the intervention in the form of once a week face-to-face sessions over one semester (3 months). These sessions would be conducted during the weekdays and at the same time as being in the kindergarten. However, the mothers' component of the intervention would incorporate both digital and face-to-face delivery. The digital delivery mode would be the predominant mode of delivery for the mothers' component, which was based on Saudi mothers' preferences.

8.3 Second stage of the intervention cultural adaptation process

The second stage of the intervention adaptation process focused on ensuring the delivery of appropriate content that would help address nutritional problems among the Saudi Arabian community. In addition to the previous reading of the literature, prior knowledge and experience as a clinical dietitian in the KSA were helpful for the adaptation process. Also, the feedback from my previous studies conducted in the region (risk factors and qualitative study in Chapters 6 and 7 respectively) were taken into account to inform the development of the appropriate content of the intervention. A summary of such feedback can be found below.

Study 1: Risk factors study (Chapter 6)

The key findings of the risk factors study (Chapter 6) that were taken into consideration while developing the intervention content included:

- Obesity risk was associated with lower vegetable intake, and higher preferences of meat, snacks and fast foods.
- Obesity risk was associated with a longer duration spent on sedentary behaviour.
- Obesity risk was associated with certain food approaches and appetite traits in the children. These included food responsiveness, food enjoyment, desire to drink and emotional over-eating.
- Scores of some inappropriate parental feeding practices (e.g. instrumental and controlling child feeding) were high, which can be associated with the risk of childhood obesity.

Study 2: Qualitative study (Chapter 7)

Several aspects of the findings of the qualitative research were taken into consideration during the intervention adaptation process. These are clarified below.

Qualitative study findings with regards to preferred format and mode of delivery of an intervention

The key findings of my qualitative study (Chapter 7) were in line with the findings of the PPI component of my research in terms of preferred format and mode of delivery to Saudi mothers.

Qualitative study findings with regards to Saudi children's dietary habits

The qualitative study reported a low fruits and vegetables intake in Saudi preschool children, and more frequent intake of less healthy food items including chips, chocolate and soft drinks as risk factors for obesity.

Qualitative study findings with regards to the barriers of adopting a healthier lifestyle

Additional key barriers were identified from the qualitative study and taken into consideration during the development of the content of the intervention. These included:

- A major barrier to physical activity in the KSA is the hot weather and lack of spaces to exercise or play in.
- It was mentioned that receiving healthy cooking recipes would be preferable.

Development of intervention content based on findings from the risk factors study and qualitative work

Taken together, all the issues mentioned above were addressed during the process of intervention content development. For example, in an attempt to solve the problem of low fruits and vegetables intake, mothers were provided with ideas to present them to children in attractive ways. For example, mothers were encouraged to engage with their children in making a happy face using vegetables, in which cucumbers can be used for the shape of the eyes, carrots for the nose and red sweet peppers for a smiling mouth. In addition, the educational materials explained to mothers that developing taste preferences in children may require 7-15 exposures to new foods⁽⁹⁰³⁻⁹⁰⁴⁾ and thus, mothers should not give up and keep trying. The advantages of providing children with

whole and preferably raw unprocessed fruits instead of juices were also explained.

In response to a mother's request to receive recipes and guidance for the preparation of more healthy meals, mothers were provided with ideas for healthy recipes suitable to the Saudi population, including cooking methods via the leaflet. They were also provided with air fryers to and induce their participation in the study and motivate adherence (Appendix J), and. To address the problem of inappropriate feeding practices, mothers were provided with information regarding feeding styles. That is, mothers were provided with information regarding undesirable parenting behaviour such as controlling, emotional and instrumental feeding styles. Such information included defining the styles and explaining how certain styles are linked to obesity in children. For example, it was explained to mothers in leaflet 6 that instrumental feeding could increase child preference towards foods offered as rewards. Offering energy-dense foods as rewards may result in weight gain.

In terms of addressing the problem of low physical activity due to the high temperature in the KSA, the intervention incorporated some suitable suggestions to keep active with respect to the hot weather. These, for example, included the suggestion to make a daily routine of walking before sunset, as the weather would likely be acceptable at that time. Another suggestion was to devote 10-15 minutes daily for the whole family to exercise together following the instructions of any preferable exercise video such as on YouTube for example. The purpose of this advice was to bring mothers' attention to the benefits of present-day technology that facilitates active engagement with exercise instructors at home. I did not name a specific programme, in order to allow mothers their personal space to choose a programme that suited their own preferences. However, if a mother asked me to suggest a programme, I provided her with a link to "Walk at Home", a programme that is available on YouTube at this link: [\(377\) Burn 10 | Walk At Home | Fitness Videos - YouTube](#).

8.4 Construction of the intervention

As mentioned previously, my PhD aimed to adapt the Trim Tots Healthy Lifestyle Programme, an existing intervention for the prevention of preschool obesity in the UK, and to subsequently develop a culturally-tailored programme suitable for the KSA. The adapted intervention was named “Healthy Living”. This current programme content has been adapted to make it culturally appropriate and translated into Arabic for a better understanding by the Saudi population. However, the method of delivery to parents is different. The intervention was tailored to suit Saudi mothers' preferences and make it feasible for the population. The section below provides details of the intervention components, the theoretical framework underpinning the intervention and clarification of the differences between the Trim Tots and Healthy Living intervention.

Intervention format and components

The Trim Tots intervention duration was 24 weeks in total. The key topics of the intervention were introduced during the first 12 weeks, and the second 12 weeks aimed to consolidate concepts learnt previously. This was achieved using practical sessions, where mothers participated in food preparation and cooking, portion size evaluation and meal planning for example. In contrast, the Healthy Living intervention duration was only 12 weeks, since the primary aim was to test the feasibility of conducting such a programme in the KSA. Another reason for reducing the intervention duration for the Healthy Living programme was to fit within the time frame of a PhD and to comply with the regulation of the scholarship provider with regard to allowed duration of conducting research outside the UK.

The Healthy Living intervention consisted of nutrition education for mothers, as well as nutrition and physical activity sessions for children. The intervention included behaviour change techniques for both mother and child. Children learned through fun sessions in the kindergarten and mothers participated mainly in digital-based interventions. However, there was a level of interaction, including mothers' attendance at three face-to-face discussion groups. During

these sessions, mothers had the opportunity to ask the dietitian (me) questions and discuss any points they were not sure about. In addition, these sessions provided an opportunity for mothers to hear from each other about the influence of the programme on their children's dietary habits and behaviours.

A summary of the intervention components is illustrated in Figure 8-2. More details, with regards to both child and parental components, are provided below.

Child component

Children took part in 12 weekly 70-minute sessions at the kindergarten. The activities within the sessions and the duration of each activity are illustrated in Figure 8-3. These sessions delivered key messages that aimed to promote a healthy lifestyle and enhance knowledge and understanding of healthy eating and physical activity. In the first 20 minutes of each session, children learned about healthy food items by colouring in pictures and discussing them with myself and/or my research assistant, both of whom have a dietetics background. The aim was to increase the level of awareness with regard to the concept of healthy foods and the benefits of eating a balanced diet.

During the second 20 minutes, the children helped in preparing a healthy snack. The aim was to familiarize them with the components of a healthy snack and to help them learn about healthy eating. Healthy snack time aimed to enhance the development of taste preferences towards healthy foods. This included providing a variety of snacks, including lower fat and sugar options that covered the major food groups. Vegetables were introduced to children in fun attractive ways such as creating happy faces. Ingredients were provided pre-chopped for the children's safety. Children mixed the ingredients and made the final touches on the plate. Ingredients for healthy snacks were bought 2-3 days before each session to ensure freshness and stored at the kindergarten. A list of snacks can be found in Appendix K. Previous research support the effectiveness of engaging children in food preparation in term of improving their dietary habits (359; 595-596).

During the final 30 minutes, children participated in music and movement sessions based on local songs available at the kindergarten. This aimed to motivate children to become more physically active. Children received reinforcement/supporting materials, including food models in the form of toys to take home and consolidate the messages learned (Appendix L). Before each session, the children's ability to join the session was assessed using a checklist adapted from the Trim Tots (Appendix M). I asked caregivers to keep the research team updated if the child developed allergy to any foods or was not feeling well that day.

Parental/Maternal component

Mothers were invited to participate in a remote digitized intervention. Leaflets were sent weekly over a 12-week period via WhatsApp (Appendix N). These leaflets were adapted from the Trim Tots intervention and translated by me. Leaflets were provided to mothers in the form of printed booklet in the Trim Tots intervention. However, the presentation was changed into an appropriate and readable digital form suitable to be sent via WhatsApp for this intervention. I translated leaflets into Arabic and incorporated Saudi foods and cultural practices to make them appropriate for the study population.

In addition to receiving weekly leaflets, mothers also received a video of a PowerPoint presentation explaining the leaflets. The PowerPoint slides were adapted from the Trim Tots intervention and translated by me. However, the PowerPoint presentations were transformed into a video form that is suitable to be sent via WhatsApp. These videos might be helpful to mothers who prefer an audio-visual format. Providing materials on WhatsApp would allow mothers flexibility to look at them at any time. Examples of topics covered by the leaflets included healthy cooking methods, the principles of a healthy balanced diet and understanding food labels. In addition, leaflets included behavioural change strategies and tools that aimed to encourage healthier lifestyles in children, for example, by increasing fruits and vegetables consumption.

An open chat via WhatsApp with mothers was provided to encourage them to ask questions regarding the educational materials received and any inquiries

were responded to promptly by me. Prompt replying to participants is proposed by previous research to increase participants adherence to the intervention⁽⁹⁰⁵⁾. Hence, by answering questions and allowing mothers to discuss points of uncertainty, it was expected that the intervention would provide adequate information to them with regard to healthy eating habits and lifestyle

Mothers were provided with an air fryer to help them prepare healthy meals at home. The purpose was to help reduce the added fat content of meals which may be present when meals are prepared using the traditional deep-frying method. Higher intake of dietary fat has been suggested to be associated with higher BMI. Fat is the most energy-dense macronutrient providing ~9 kcals/gram compared with protein and carbohydrate, which provide ~4 kcals/gram. Therefore, fat added in cooking increases the energy density of such foods prepared. This may increase overall energy intake, raising the possibility of a positive energy balance⁽⁵⁹⁸⁾.

Studies have suggested that using an air fryer could be a good alternative to the traditional deep-frying method⁽⁹⁰⁶⁾. Air frying was found to result in a 74% reduction in the total fat content of a meal in one study⁽⁹⁰⁷⁾. Other studies found that the fat content of chicken nuggets and potato strips was significantly lower using an air fryer compared to the deep-frying method⁽⁹⁰⁸⁻⁹⁰⁹⁾.

It is worth noting that the programme was open to all parents. However, in the context of Saudi culture, mothers or female carers are the principal guardians, who were eligible to attend the meeting in the kindergarten and complete the registration forms. Therefore, contacting mothers or female carers was a dominant feature in this study.

Theoretical Framework

The intervention employed a theoretical framework based on Social Cognitive Theory (SCT)⁽⁹¹⁰⁾ to guide the intervention child component. This is because, the basic element of Social Cognitive Theory is that children learn by observation and imitation⁽⁶⁸²⁾. The intervention targeted parents since they are considered to be the agents of change. The transtheoretical model of change (TTM) was applied to encourage behaviour change in the mothers' intervention

component. This is because the transtheoretical model of change would mainly focus on enhancing motivation toward behaviour change ⁽⁶⁹⁰⁾. This could be achieved by the implementation of strategies that stimulate the process of change, including consciousness raising and environment re-assessment ⁽⁶⁹¹⁾.

Dimensions of the transtheoretical model of change were incorporated in the mother's intervention components. Mothers were taught behaviour change techniques and provided with tools to help achieving goals during the course of the intervention. Each technique was presented separately within the leaflets. Mothers were encouraged to apply each technique as all had been previously shown to help affect behaviour change.

Behaviour change techniques offered to mothers included: 1) goal setting, 2) prompt review of behavioural goals, 3) environmental restructuring and 4) prompt rewards contingent on successful behaviour. Mothers received a combination of such behaviour change techniques via the leaflets (Appendix N). Each leaflet included an activity page that encouraged the mother to adopt either a specific behaviour change technique or provided her with effective information to help her child to develop healthier dietary habits.

The leaflet of the 1st week provided information regarding adverse health consequences of overweight/obesity in order to raise the mothers' level of consciousness. Then, mothers were encouraged to assess their readiness to change by providing them with an explanation of the stages of change and allowing them to distinguish at which level they are.

In the 2nd week, mothers were taught goal setting techniques by video. The video sessions explained to mothers how to set them with examples. An example of an imprecise goal would be "going for more swimming sessions", whereas an example of a SMART goal would be "going swimming each Saturday afternoon of this month". SMART goal setting could result in higher self-esteem, which is associated with potential progress in the behaviour change process ⁽⁶⁸⁶⁾.

In the 3rd and 4th week, mothers were provided with another technique known as the prompt review of behavioural goals. Using this strategy, mothers could learn how to review and evaluate their progress in achieving goals set in the previous week. Where they did not achieve their goals, mothers learned how to identify barriers to achieving these goals and how to set alternative goals. As a motivation to achieve goals, mothers were encouraged to compare the advantages and disadvantages of the changes needed to achieve their set goals. This could lead to a positive attitude towards the targeted behaviour, by possessing mothers' awareness of the advantages of the new behaviour that outweighed the disadvantages ⁽⁶⁹²⁾.

In the 5th week, mothers were provided with a technique known as prompt rewards contingent on successful behaviour. This technique was shown to result in an improvement in child eating habits and higher consumption of fruits and vegetables ⁽²⁸²⁾. Therefore, mothers were encouraged to reward successful behaviour developed by their children. Moreover, mothers were encouraged not to neglect the child's effort toward the successful behaviour. It is important to praise their children's efforts to achieve goals. Mothers were offered a variety of reward ideas that were not costly, including reading a new story, going out and playing on a swing or providing the child with a sticker on a reward chart.

In the 6th week, mothers were provided with information about effective parenting, since previous research indicated that effective parenting was associated with lower risk of obesity in preschool children ⁽⁹¹¹⁾. For example, it was explained to mothers that the three main components of an effective parenting style are: 1) warmth, 2) control and 3) structure. Mothers were encouraged to indirectly control their children's eating and to help them to make healthier dietary choices by providing the child with appropriate choices and allowing them to select what they prefer.

In the 7th week, mothers were given practical information on how to act as a role model to encourage healthy lifestyles in their children. It is important to note that, the literature had highlighted the positive impact of parental

modelling on child eating habits and in the acceptance of new foods ⁽²⁸²⁾. This included modelling with words, where parents stated preferences for healthier foods in the presence of the child. Another method of modelling taught was eating certain foods in front of children and using facial expressions to express a liking for particular foods.

In the 8th week, mothers learned an environmental restructuring technique. This is because increasing availability and acceptability of healthy foods were found to be associated with healthier dietary intake ⁽⁹¹²⁾. Recommendations with regards to environmental restructuring included an explanation of how to rearrange their home environment; for example, by keeping foods high in fats and sugars out of sight, while making healthier foods available and easily accessible.

The leaflet of the 9th week provided recommendations for mothers to deal with the fussy eater child. Examples of these recommendations included never force feeding a child and turning meals into a social occasion by eating with your child. Another recommendation was to offer small portions of a healthy food and praise the child if they eat their food. These recommendations were useful in reducing food fussiness in children ⁽⁹¹³⁾.

The leaflet of the 10th week provided information on menu planning, including meal pattern and portion size. That is, a balanced diet and appropriate portion sizes are associated with balanced-energy intake ⁽⁹¹⁴⁾. The leaflet of the 11th week taught the mothers how to read labels on products, and accordingly, how to choose healthier food options (e.g. lower fat/sugar products). Previous research indicated that learning how to read nutrition label is very likely associated with healthier food choices ⁽⁹¹⁵⁾. The leaflet of the 12th week encouraged the mothers to make sure that they and their child were eating a healthy balanced diet and to keep physically active.

Differences between the Trim Tots and Healthy Living study

Table 8-1 Provided a comparison of both Trim Tots and the healthy Living intervention formulas. Of note, one of the major differences between the Healthy Living and Trim Tots was that in the Trim Tots mothers came along with their children to attend the sessions, while in the Healthy Living intervention, they participated digitally via WhatsApp and were invited to attend a monthly discussion group session in the kindergarten (i.e. reduced personal attendance). This approach was chosen because, although Saudi mothers stated that they preferred their children to participate in learning by fun sessions during the weekdays in the kindergarten, they preferred to participate digitally due to their busy schedules. These mothers preferred to be contacted via WhatsApp to receive the educational materials. Many mothers said that they could attend one face-to-face session each month. Leaflets used in the Trim Tots intervention were updated and presented in a different form in the Healthy Living programme. Leaflets were handed to mothers as booklets in the Trim Tots intervention, while in the Healthy Living intervention, mothers received the leaflet in a form suitable to be sent and read on a smartphone. PowerPoint presentations were used to explain the leaflets in the Trim Tots intervention during the regular face-to-face sessions. This differs in the Healthy Living study wherein these presentations were adapted and transformed into videos that were sent weekly via WhatsApp.

Table 8-1 Comparison between Trim Tots and Healthy living intervention

Trim Tots	Healthy Living
Duration: 24 weeks (12 main sessions + 12 consolidation sessions)	Duration: 12 weeks (12 sessions)
Child component:	Child component:
Arts and crafts (40 min)	Colouring (20 min)
Eating healthy snacks (15 min)	Preparing and eating healthy snacks (20 min)
Music and movement (20 min)	Music and movement (30 min)
Preparing showcase about healthy foods	Providing supplementary material (e.g. toys) to consolidate the message learnt during the sessions regarding healthy diet
Use of food and plate models to play making healthy meals	
Parental component:	Parental component
Weekly face-to-face sessions	Weekly digital communication via WhatsApp
Handing printed booklets of educational material	Sending PDF of educational material
Providing educational PowerPoint presentation	Sending a video of educational PowerPoint presentation
Recipe book suggestions	Invitation to attend a monthly face-to-face discussion sessions
Providing physical activity equipment (e.g. Swiss balls, Dyna-bands and hand-weights)	Providing air fryers
Mock supermarket setting using packaging and products to understand labels	
Provision of pocket guide for exercise	

8.5 Chapter Summary

The Trim Tots healthy lifestyle programme is a multicomponent intervention, developed to comply with and meet the requirements for the UK NICE guidelines for childhood obesity prevention interventions. However, despite the high prevalence of obesity and a great need for obesity interventions, no such interventions are available in KSA. Therefore, this project aimed to adapt the Trim Tots intervention, tailor it to suit the Saudi Arabian community and simplify its delivery methods to make it more suitable for KSA parents. The adaptation process went through two main stages.

In the first stage, the PPI exercise and qualitative study found that Saudi mothers contacted as part of this study were willing to register their children in a healthy lifestyle programme conducted in the kindergarten. However, the exercise found that mothers preferred to receive educational information digitally to reduce the need for personal attendance. This was confirmed by the qualitative work (Chapter 7). Accordingly, the intervention was designed to be delivered in this way. The second stage of the adaptation process tailored the content of the Trim Tots intervention to focus on reducing risk factors for obesity in a Saudi Arabian population. Findings from the risk factors research (Chapter 6) and feedback from the qualitative study (Chapter 7) were taken into consideration during the preparation of the intervention content. The adapted intervention was named the "Healthy Living". The feasibility of such an intervention was tested through a pilot RCT conducted in the Makkah region of the KSA as described by the next chapter (Chapter 9).

Figure 8-2 Diagram summarising the intervention components

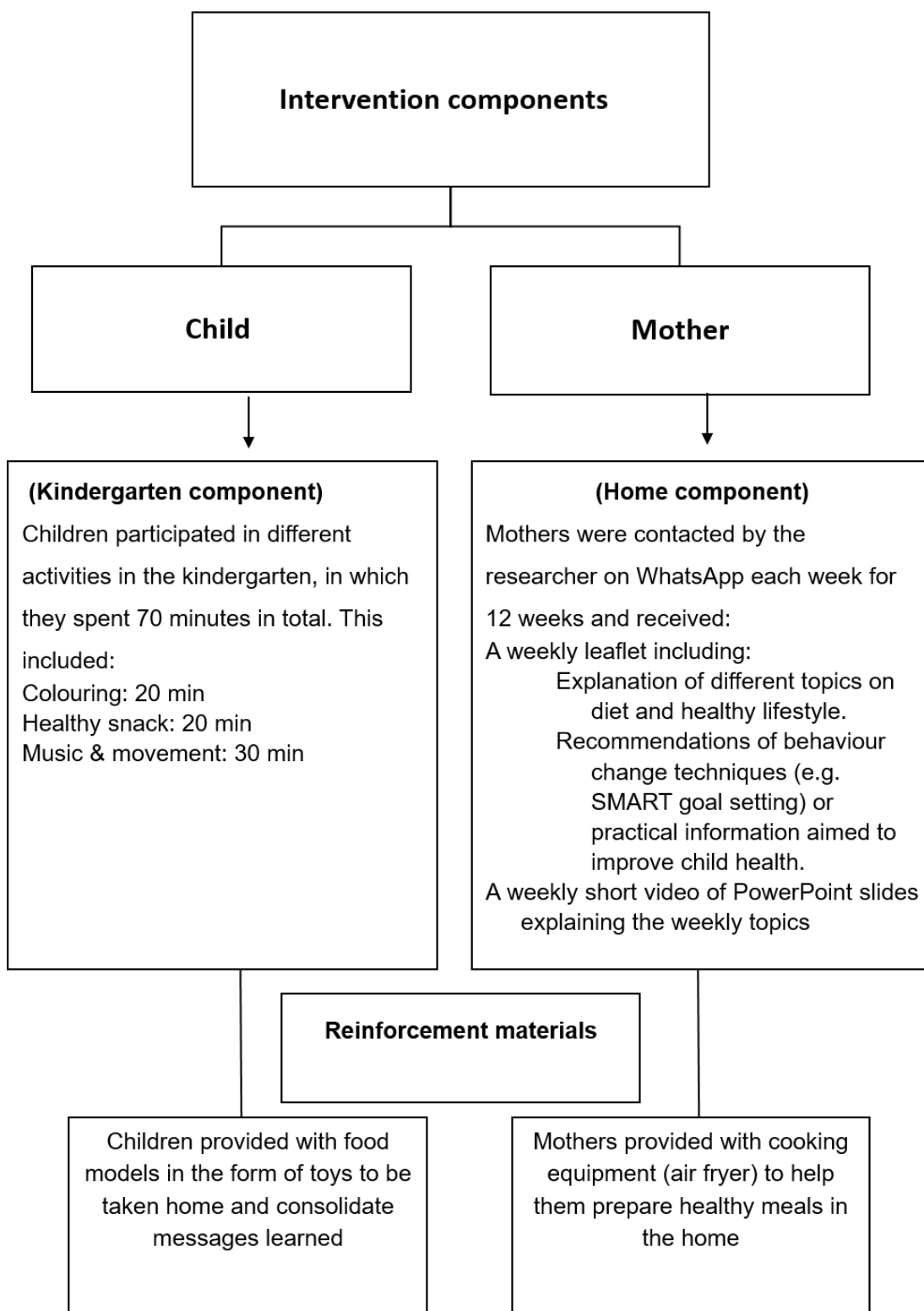
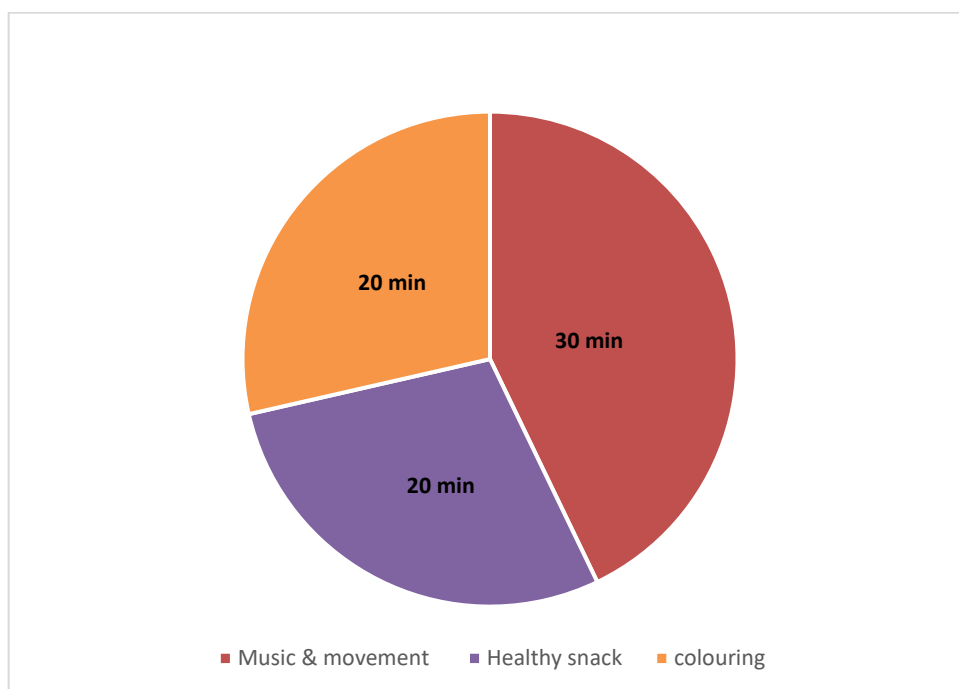


Figure 8-3 Breakdown of activities in weekly sessions for children at the kindergarten



9. Chapter 9: Study 4 Results, A feasibility study to assess a childhood obesity prevention intervention in the KSA

9.1 Introduction

Several approaches have been suggested to help reduce the prevalence of obesity in different countries. In the UK, for example, the National Institute of Care Excellence (NICE) guidelines recommend multicomponent interventions that target children and their families, ideally with using health behaviour change strategies as the best way to achieve this. Trim Tots is one such intervention that complies with NICE guidelines and has evidence of success in reducing obesity risk in preschool children⁽⁵⁸⁸⁾. As yet, there is no obesity preventative intervention in the KSA that targets preschool children; this thesis aimed to adapt and test the feasibility of the Trim Tots intervention for the Saudi Arabian population. The adapted intervention, named "Healthy Living", and the adaptation process, have been described previously in Chapter 8.

The primary aim of this study was to assess the feasibility of conducting such an intervention in the KSA. The secondary aim of conducting this pilot RCT trial was to evaluate health effects of the intervention using BMI z-score as the primary outcome. Secondary outcomes included any increase in fruit and vegetable intake and time spent in physical activity. Primary and secondary statistical analysis were used to test the intervention effect on the BMI z-score. Methods and outcome measures for this have been described in detail in Chapter 5.

9.2 Results

30 child-mother dyads were recruited and assigned randomly either to intervention or control groups. 24 participants completed the intervention and 17 provided anthropometric measurements at follow-up 6 months after the end of intervention [see participant flow diagram (Figure 9-1)]. The primary statistical analysis compared the absolute difference in BMI z-score between randomised groups at the end of the intervention. In secondary analyses, the mean difference in change in BMI z-score between the study baseline and the

end of the intervention (pre- and post- values) was compared between randomised groups. Both methods produced similar results after adjustment for baseline values.

Other outcomes (e.g. dietary intake and physical activity) were assessed by comparing the absolute difference between randomised groups, at the end of the intervention. Within subject change, which considered the difference between the study baseline and at the end of the intervention, was also evaluated in each randomised group separately. Descriptive characteristics are presented in Tables 9-1 to 9-6, while results of comparisons between groups are presented in Tables 9-7 to 9-22.

9.3 Response rate and participant's adherence to the study.

Forty-one mothers responded to the initial invitation to participate in the study. Thirty out of forty-one mothers (73%) contacted agreed to participate. The adherence rate of the intervention was high, with 80% of participants (24/30 mother-child dyads) remaining in the study at the end of the intervention (3 months from baseline). 57% (17/30 mother-child dyads) provided measurements at the 6-months follow-up, after the end of the intervention (9 months from baseline) (Figure 9-1). The follow-up point coincided with the national lockdown in the KSA during the COVID-19 pandemic. Therefore, it was not possible to measure the participants personally.

To address the problem of not being able to have a personal contact with the participants during the pandemic, mothers were provided with guidelines for measurement and reporting of height and weight in their children. This was adapted from the British Dietetic Association (BDA) guidelines for remote dietetics consultation during the COVID-19 pandemic⁽⁷⁴¹⁾. For example, when measuring height, the mother is advised to stand the child against a wall and ensure the back of the head, shoulder blades, buttocks, calves and heels touch the wall. The child's head must be positioned in the Frankfurt plane, where a horizontal line runs from the ear canal to the lower border of the eye socket. A flat object such as a hardback book is then placed on the child's head and a mark is drawn at the lower margin where the book meets the wall. The child is

instructed to step away and height is measured using a tape from this point to the floor. The child's height in centimetres to the last completed 0.1cm (if possible) is recorded. A full version of these guidelines can be found in Appendix O.

9.4 Compliance with intervention components

Of the total 12 sessions conducted in the kindergarten for children, the mean (SD) number of sessions attended was 10 (0.1), representing an 83% attendance rate. Mean (SD) attendance at 3 discussion groups held in the kindergarten for mothers was 2 (0.6), representing a 66.7% attendance rate. All mothers accessed educational materials sent via WhatsApp. Details of attendance are in Appendix P.

9.5 Safety

There were no adverse events reported. In addition, none of the mothers had concerns regarding any issues that might affect the child's psychological wellbeing. Therefore, it can be concluded that applying the intervention was safe.

9.6 Mothers' feedback with regards to the intervention

Thematic analysis was used to extract and collate mothers' feedback with regard to the intervention using NVIVO11 software (QSR International Pty Ltd., Burlington, MA). Themes and subthemes that emerged from the thematic analysis are presented in Figure 9-2. It is worth noting that the study did not include qualitative analysis, but a thematic analysis of the data was helpful in categorising the feedback of the mothers. The analysis identified 3 main themes labelled as follows: "Acceptability of the intervention", "Advantages of the intervention" and "Suggestions to improve the intervention". Quotes in support of each theme can be found in Figures 9-3, 9-4 and 9-5. Each quote is coded with the participant's ID number, which is related to "Healthy Living Study Intervention" (HLSI). More details regarding the extracted themes are provided below.

The First Main Theme

The first main theme, which was labelled "Acceptability of intervention", (Figure 9-2) suggested that the intervention was acceptable by mothers and children. As shown in Figure 9-3, a representative quote by one of mothers, for example, included:

"It was a successful and thorough programme. The magnitude of efforts made was obvious and touchable" (Participant ID HLSI.12).

Another mother, the mother of participant ID HLSI.29, said:

"The programme deserves 10/10" (Figure 9-3).

The Second Main Theme

The second main theme was about "Advantages of the intervention", in which three subthemes emerged: 1) usefulness of the intervention for the whole family 2) improvement of child awareness with regard to healthy foods and 3) improvement of child dietary habits (Figure 9-2).

According to the first subtheme, mothers found the intervention helpful and useful, not only for their children, but also for the whole family. For instance, the mother of participant ID HLSI.29 said:

"It was useful for my son, and for me as a mother. I applied the information I got with my other children" (Figure 9-4).

Another mother, the mother of participant ID HLSI.03, said:

"It was very helpful for the whole family and the information was useful" (Figure 9-4).

In the second subtheme, it was mentioned that children started to become aware of the concept of healthy and unhealthy foods as a result of the intervention. A representative quote, for example, was:

"My daughter became our instructor at home, and she tells us what is healthy and what is not. I found it fabulous when she reminded us of

eating fruits, not drinking the juice" (participant ID, HLS.I.06), (Figure 9-4).

Another mother said:

"My daughter started to know what is healthy and what is not. She tells her brother what he should eat. Although she still asks for candies sometimes but she asks less now" (participant ID, HLS.I.13), (Figure 9-4).

Furthermore, according to the third subtheme, this qualitative analysis suggested that the intervention was effective in terms of improving children's dietary habits. As shown in Figure 9-4, mothers reported that children started eating more fruits and vegetables and avoiding soft drinks. For instance, the mother of participant ID HLSI.02 said

"My son's dietary habits improved. He likes the fruits and vegetables snacks now".

Another representative quote, came from the mother of participant ID HLSI.10, in which she said:

"He used to love chips and soft drinks regardless of my effort to stop him from eating these things. But the programme encouraged him to love eating healthy foods. Now even if someone offers him unhealthy foods, he refuses it and this is a huge achievement".

Further representative quote by mother of participant ID HLSI.16:

"My daughter started to eat new and healthier foods. And she started to ask for specific new foods" (Figure 9-4).

The Third Main Theme

The third main theme included suggestions provided by mothers to improve the intervention in the future and was divided into 2 subthemes. One subtheme included suggestions to extend the duration of the intervention. For instance, a mother said:

"It will be better if the programme was longer" (participant ID HLSI.08), (Figure 9-5).

The other subtheme included suggestions for intervention sustainability (i.e. to make the intervention always available). For example, a mother said:

"I hope if it is always available" (participant ID, HLSI.16), (Figure 9-5).

Another mother said:

"I wish if this programme can be applied as predominant part of curriculum in preschool and in the schools as well" (participant ID, HLSI.10), (Figure 9-5).

9.7 Baseline sociodemographic and anthropometric characteristics

Sociodemographic and anthropometric characteristics of the study population are presented in Tables 9-1 and 9-2. The mean (SD) age of participating children was 4.5 (1.0) years. 43% were male, while 57% were female. The proportion of males to females was similar to that reported in a large national study by El Mouzan et al. (2010) ⁽⁴¹⁰⁾ (males 50.5% and females 49.5%). All participants in the intervention were of Saudi Arabian nationality. This is higher than the national proportion of Saudi to non-Saudi preschool children, based on the 2018 report from the general authority for statistics in the KSA (79.2% Saudi vs 20.8% non-Saudi) ⁽⁹¹⁷⁾. Another national study reported similar findings to the national statistics (80.2% Saudi vs 19.8% non-Saudi) ⁽⁴¹⁰⁾.

Fathers and mothers with a university degree represented 73.3% and 70% of the studied sample, respectively. This is higher than the national proportion of Saudi adults with a university degree, which was reported by the general authority for statistics in the KSA in 2017. That is, males and females with university degree represent 28.1% and 25.5% of the population respectively ⁽⁷⁴⁴⁾. However, our sample was comparable to the findings of a more recent study which was conducted by Mesawa et al. (2020). It was reported that males and females with a university degree represented 62.2% and 54% of the studied sample respectively ⁽⁴³¹⁾.

All fathers were of non-manual occupation (Table 9-1). This data could not be compared to national data because precise information was not provided by the general authority of statistics in the KSA. However, a study conducted by Darwish et al. (2014) reported that fathers with non-manual occupations represented 90% of their sample size, which is comparable to our findings ⁽⁴⁴⁹⁾.

The mean (SD) BMI and BMI z-score of children was 18.5 (2.5) and 1.5 (1.0), respectively. The mean (SD) BMI of mothers was 27.1 (3.6) kg/m² (Table 9-2). The study population was specifically chosen according to certain inclusion criteria, in which eligible children were either with overweight/obesity or at risk of developing obesity. Therefore, comparison with national data was not appropriate.

9.8 Home environment and lifestyle characteristics

Characteristics of the home environment and children's physical activity behaviours were collected using questionnaires and presented in Table 9-3. This includes information sedentary behaviours defined by watching TV. Moreover, this includes information on the amount of time spent in physical activity, such as playing actively indoors or outdoors (more details can be found in Chapter 5).

80% of participants reported having an inside play area and 56.7% lived in a neighbourhood with a suitable outside play area or yard. In addition to using a car, 36.7% of families reported they also used walking as a form of transportation. Half of the studied sample (50%) watched TV for more than one hour/day, while a proportion of the children (56.7%) played actively for more than one hour/day (Table 9-3).

9.9 Parental feeding style and child eating behaviour

Mean (SD) scores for parental feeding style and child eating behaviours are presented in Table 9-4. Out of four parental feeding style categories investigated, encouragement to eat scored highest [mean (SD) score: 4.0 (0.5)] and emotional feeding scored lowest [mean (SD) score: 2.4 (0.9)]. Out of the eight child eating behaviours investigated, enjoyment of food scored

highest [mean (SD) score: 3.6 (0.8)], while satiety responsiveness scored lowest [mean (SD) score: 2.7 (0.8)].

9.10 Food preferences and food frequency intake

Children's preference scores for different food groups are displayed in Table 9-5. The highest value on the numeric scale used to measure food preference was five. Snack preference scored highest [mean (SD) score: 3.9 (0.4)], while vegetable preference scored lowest [mean (SD) score: 2.8 (0.5)].

Table 9-6 presented the average daily servings of the five main food groups, each food group score and the total Healthy Plate Variety Score (HPVS). The ideal food group score is one, and the HPVS score is five. In this sample, total HPVS was 2.8 (0.9). The meat food group scored highest [mean (SD) score: 0.8 (0.4)], while the vegetable group scored lowest [mean (SD) score: 0.3 (0.3)].

9.11 Primary outcome - comparison of BMI z-score between intervention and control group

BMI measurements were taken at baseline, at the end of intervention (3 months from baseline) and at follow-up 6 months after intervention completion (9 months from baseline). The primary outcome was BMI z-score immediately after intervention (3 months from baseline). Changes in anthropometric measurements of study participants are presented in Tables 9-7, 9-8, 9-9 and 9-10.

At the end of the intervention (3 months from baseline)

BMI z-score in children

Primary analysis (comparison of absolute difference in BMI z-score between randomised groups)

At the end of the intervention, the primary analysis found that the mean BMI z-score was lower in children in the intervention group compared with the control group, [mean difference, -0.4 scores (95% CI: -1.2 to 0.4; p=0.3)]. After

adjustment for sex, age and baseline BMI z-score, the mean difference in BMI z-score between randomized groups was -0.06 (95% CI: -0.3 to 0.2; $p=0.6$), (Table 9-7). However, the difference was not significant.

Secondary analysis (comparison of change in BMI z-score between randomized groups)

The change in BMI z-score from baseline to immediately after the intervention was greater (-0.09 scores) in the intervention group than in the control group (-0.06 scores). The mean difference of the change in BMI z-score between groups was -0.03 (95% CI: -0.3 to 0.3; $p=0.8$). After adjustment for age, sex and baseline BMI z-score, the mean change in BMI z-score became -0.06 (95% CI: -0.3 to 0.2; $p=0.6$), (Table 9-7).

Within subject analysis

BMI z-score decreased in children in the intervention group immediately after completion the intervention compared to baseline [mean difference: -0.09 scores (95% CI: -0.3 to 0.1; $p=0.4$)]. Children in the control group also had a lower BMI z-score after the intervention compared to baseline [mean difference -0.06 scores (95% CI: -0.1 to 0.04; $p=0.1$)], (Table 9-8).

BMI in children

Comparison between randomised groups

At the end of the intervention, the BMI of children in the intervention group was lower than the BMI of children in the control group [mean difference -1.0 kg/m² (95% CI: -0.3 to 0.9; $p=0.3$)]. After adjustments for age, sex and baseline BMI, the BMI of children in the intervention group was lower than that of children in the control group by 0.3 kg/m² (95% CI: -0.7 to 0.2; $p=0.2$) at the end of the intervention. However, the BMI difference between randomised groups was not significant (Table 9-7).

Comparison of change in child BMI, from baseline to immediately after the intervention, between the randomized groups found that the change in BMI of children in the intervention group was greater (-0.3 kg/m²) compared to the

control (-0.1 kg/m²). The mean change in BMI between groups was -0.2 kg/m² (95% CI: -0.7 to 0.2; p=0.2). After adjustment for confounding factors including age, sex and baseline BMI, the mean difference in BMI change was -0.3 kg/m² (95% CI: -0.7 to 0.2; p=0.2), (Table 9-7). However, the mean difference of change in child BMI between randomised groups was not significant (Table 9-7).

Within subject analysis

Immediately after intervention, the BMI of children in the intervention group was lower compared with baseline [mean difference -0.3 kg/m² (95% CI: -0.8 to 0.1 kg/m²; p=0.09)]. Children in the control group also had a lower BMI after the intervention compared to baseline [mean difference, -0.1 kg/m² (95% CI: -0.3 to 0.1 kg/m²; p=0.2)], (Table 9-8).

BMI in Mothers

Comparison between randomised groups

At the end of the intervention, the mothers of children in the intervention group had a lower BMI compared to the mothers of children in the control group [(mean difference -0.5 kg/m² [95% CI: -3.4 to 2.4 kg/m²; p=0.7)]. The difference was significant after adjustment for baseline BMI [mean difference -0.4 kg/m² 95% CI: -0.8 to -0.1 kg/m²; p=0.02)], (Table 9-7).

The change in mother's BMI from baseline to immediately after the intervention was greater (-0.5 kg/m²) in the intervention group compared to the control (-0.1 kg/m²). The mean change in mother's BMI between groups was -0.4 kg/m² (95% CI: -0.8 to 0.1 kg/m²; p=0.09). The effect size did not differ after adjustment for baseline mother BMI (Table 9-7).

Within subject analysis

BMI of mothers of children in the intervention group decreased significantly at the end of the intervention compared to baseline [mean difference -0.5 kg/m² (95% CI: -0.9 to 0.1 kg/m²; p=0.02)]. Mothers of children in the control group had a slightly lower BMI at the end of the intervention compared to baseline

[mean difference -0.1 kg/m² (95% CI: -0.3 to 0.2 kg/m²; p=0.5)]; however, this reduction was not significant (Table 9-8).

Follow-up 6 months after intervention completion (9 months from baseline)

BMI z-score in children

Comparison between randomised groups

At 6 months follow-up after intervention completion, the BMI z-score of children in the intervention group was lower than that in the control group [mean difference -0.3 scores (95% CI: -1.4 to 0.8 p=0.5)]. After adjustment for possible confounding factors including age, sex and baseline BMI z-score, the difference in BMI z-score between groups was -0.08 scores (95% CI: -0.4 to 0.2; p=0.6), (Table 9-9).

The change analysis (from baseline to 6 months following intervention completion) found a reduction in child's BMI z-score for children in the intervention group (-0.09 scores), but no change in the control group. The mean difference in the change of BMI z-score between groups was -0.09 scores (95% CI: -0.4 to 0.2; p=0.5). After adjustments for age, sex and baseline BMI z-score, the mean difference in BMI z-score change became -0.08 (95% CI: -0.4 to 0.2; p=0.6) (Table 9-9).

Within subject analysis

BMI z-score of children in the intervention group was lower at 6 months follow-up intervention completion compared to baseline [mean difference -0.09 scores (95% CI: -0.3 to 0.1; p=0.3)], while it did not change for children in the control group (Table 9-10).

BMI in children

Comparison between randomised groups

At 6 months following intervention completion, BMI of children in the intervention group was lower than that in the control group [mean difference -

1.0 kg/m² (95% CI: -3.5 to 1.6 kg/m²; p=0.4)] at 6 months follow-up. After adjustment for age, sex and baseline BMI, BMI of children in the intervention group was lower than that in the control group by 0.3 kg/m² (95% CI: -1.1 to 0.4 kg/m²; p=0.3), (Table 9-9). The difference, however, was not significant.

With regard to the comparison of change from baseline to 6 months after intervention completion between the randomized groups, it was found that the change in BMI of children in the intervention group was -0.3 kg/m², while there was no change in the control group. Mean difference in change between the randomised groups at 6 months follow up was -0.3 kg/m² (95% CI: -1.0 to 0.2; p=0.2). However, the difference of change between groups was not significant. This result did not differ after adjustment for confounding factors including age, sex and baseline BMI (Table 9-9).

Within subject analysis

BMI of children in the intervention group was lower at 6 months follow-up from intervention completion compared to baseline [mean difference -0.3 kg/m² (95% CI: -0.7 to 0.1; p=0.1)], while there was not any change in BMI of children in the control group (Table 9-10).

BMI in Mothers

Comparison between randomised groups

At follow-up 6 months after the end of the intervention, the mean difference in BMI in mothers of the children in the intervention and control group was 0.3 kg/m² (95% CI: -3.7 to 4.2; p=0.9). After adjustment for baseline BMI, the mothers of children in the intervention group had a lower BMI compared to mothers of children in the control group [mean difference -0.5 kg/m² (95% CI: -0.9 to -0.01; p=0.04)], (Table 9-9).

Change analysis (from baseline to 6 months following intervention completion) found that BMI for mothers in the intervention group reduced by -0.4 points, while it increased by 0.1 kg/m² in the control group. The mean difference in change in mother's BMI from baseline to 6 months after intervention

completion was -0.5 kg/m^2 (95% CI: -1.2 to 0.1 ; $p=0.07$). This was similar to the result after adjustment for baseline measurements (Table 9-9).

Within subject analysis

BMI in mothers of children in the intervention group was lower at 6 months follow up compared to baseline [mean difference -0.4 kg/m^2 (95% CI: -0.9 to 0.1 ; $p=0.07$)]. Conversely, BMI of mothers of children in the control group increased slightly at 6 months follow-up compared to baseline [mean difference 0.1 kg/m^2 (95% CI: -0.1 to 0.3 ; $p=0.4$)], (Table 9-10).

9.12 Comparison of sedentary and active behaviours between groups

Comparison of absolute difference between groups

As shown in Table 9-11, the proportion of children who spent more than one hour watching TV or playing actively did not differ significantly between randomised groups at the end of the intervention.

9.13 Comparison of parental feeding style and child eating behaviour between groups

Effects of the intervention on parental feeding styles are presented in Tables 9-12 and 9-13, while effects on child eating behaviours are presented in Tables 9-14, 9-15 and 9-16.

Parental feeding style

Comparison of absolute difference between groups

At the end of the intervention, instrumental feeding was significantly lower in mothers of children in the intervention group compared to mothers of children in the control group [mean difference -0.7 scores (95% CI: -1.1 to -0.3 ; $p=0.001$)]. This finding remained significant after adjustment for maternal age and baseline feeding style [mean difference -0.7 scores (95% CI: -1.1 to 0.3 ; $p=0.001$)], (Table 9-12).

Within subject analysis

Instrumental feeding style was lower by -0.4 scores (95% CI: -0.9 to 0.1; $p=0.1$) at the end of the intervention compared to baseline in mothers of children in the intervention group. Meanwhile, it was only lower by -0.1 scores (95% CI: -0.8 to 0.7; $p=0.9$) in mothers of children in the control group (Table 9-13).

Child eating behaviour

Comparison of absolute difference between groups

Child eating behaviours did not differ significantly between groups at the end of the intervention (Table 9-14).

Within subject analysis

The desire to drink in children in the intervention group decreased at the end of the intervention compared to baseline (mean difference -0.3 scores (95% CI: -0.6 to 0.1; $p=0.08$). Conversely, desire to drink increased slightly in the control group [mean difference 0.1 scores (95% CI: -0.4 to 0.5; $p=0.9$)], (Table 9-15).

9.14 Comparison of food preferences and intake between groups

Food preference scores are presented in Tables 9-17 and 9-18. Food frequencies and Healthy Plate Variety Score (HPVS) are presented in Tables 9-19, 9-20 and 9-21.

Comparison of absolute difference between groups

At the end of the intervention, the frequency of fruit and vegetable intake was significantly higher in children of the intervention group compared to the control group [mean difference in fruit intake 0.6 portions/day (95% CI: 0.2 to 0.1; $p=0.005$), a mean difference in vegetable intake 0.7 portions/day (95% CI: 0.1 to 1.2; $p=0.01$)], (Table 9-19). After adjustment for age, sex and baseline measurement (i.e. baseline frequency of fruit and vegetable), the effect of the intervention was slightly attenuated. However, the frequency of

fruit and vegetable intake remained significantly higher in children of the intervention group compared to the control group [mean difference in fruit intake 0.5 portions/day (95% CI: 0.1 to 0.9; $p=0.01$), mean difference in vegetable intake 0.6 portions/day (95% CI: 0.1 to 1.1; $p=0.008$)], (Table 9-19).

Finally, at the end of the intervention, HPVS was significantly higher in children of the intervention group compared to children in the control group [mean difference 0.7 scores (95% CI: 0.2 to 1.4; $p=0.005$)]. After adjustment for age, sex and HPVS baseline, the effect attenuated, but the difference was still significantly higher in children of the intervention group compared to children of the control group [mean difference 0.4 scores (95% CI: 0.1 to 0.8; $p=0.01$)], (Table 9-19).

Within subject analysis

The frequency of fruit intake at the end of the intervention in children of the intervention group increased by 0.4 portions/day (95% CI: -0.1 to 0.9; $p=0.08$) compared to baseline. Meanwhile, fruit intake in children of the control group did not change at the end of the intervention compared to baseline (Table 9-20).

With regards to vegetable intake, within subject analysis showed a significant increase of vegetable intake frequency in children of the intervention group by the end of the intervention [mean difference 0.6 portions/day (95% CI: 0.04 to 1.3; $p=0.04$)] compared to baseline. Vegetable intake frequency increased slightly in children of control group at the end of the intervention compared to baseline [mean difference 0.1 portions/day (95% CI: -0.1 to 0.4; $p=0.3$)] (Table 9-20).

Within subject analysis also showed that the total HPVS increased in both groups by the end of the intervention compared to baseline. However, this increase was higher in children of the intervention group. That is, HPVS in children of the intervention group increased by 0.4 scores (95% CI: -0.1 to 0.9; $p=0.08$) compared to baseline, while it increased by 0.3 scores (95% CI: -0.1 to 0.7; $p=0.1$) in children of the control group (Table 9-21).

9.15 Summary of findings

The Healthy Living childhood obesity prevention intervention was feasible and acceptable in the KSA, with evidence of a high rate of compliance and acceptance. For example, measuring weight, height and waist circumference was acceptable to children and mothers, as was contacting mothers via WhatsApp and completing the questionnaires.

Although BMI z-score in children did not differ significantly between groups at the end of the intervention, mothers of children in the intervention group had significantly lower BMI compared to mothers of children in the control group following intervention. The intervention also showed positive effects on children's dietary habits and parental feeding styles. For example, the intervention resulted in lower scores for instrumental feeding in mothers of children in the intervention group. Furthermore, children in the intervention group had higher intakes of fruits and vegetables compared to their counterparts in the control group.

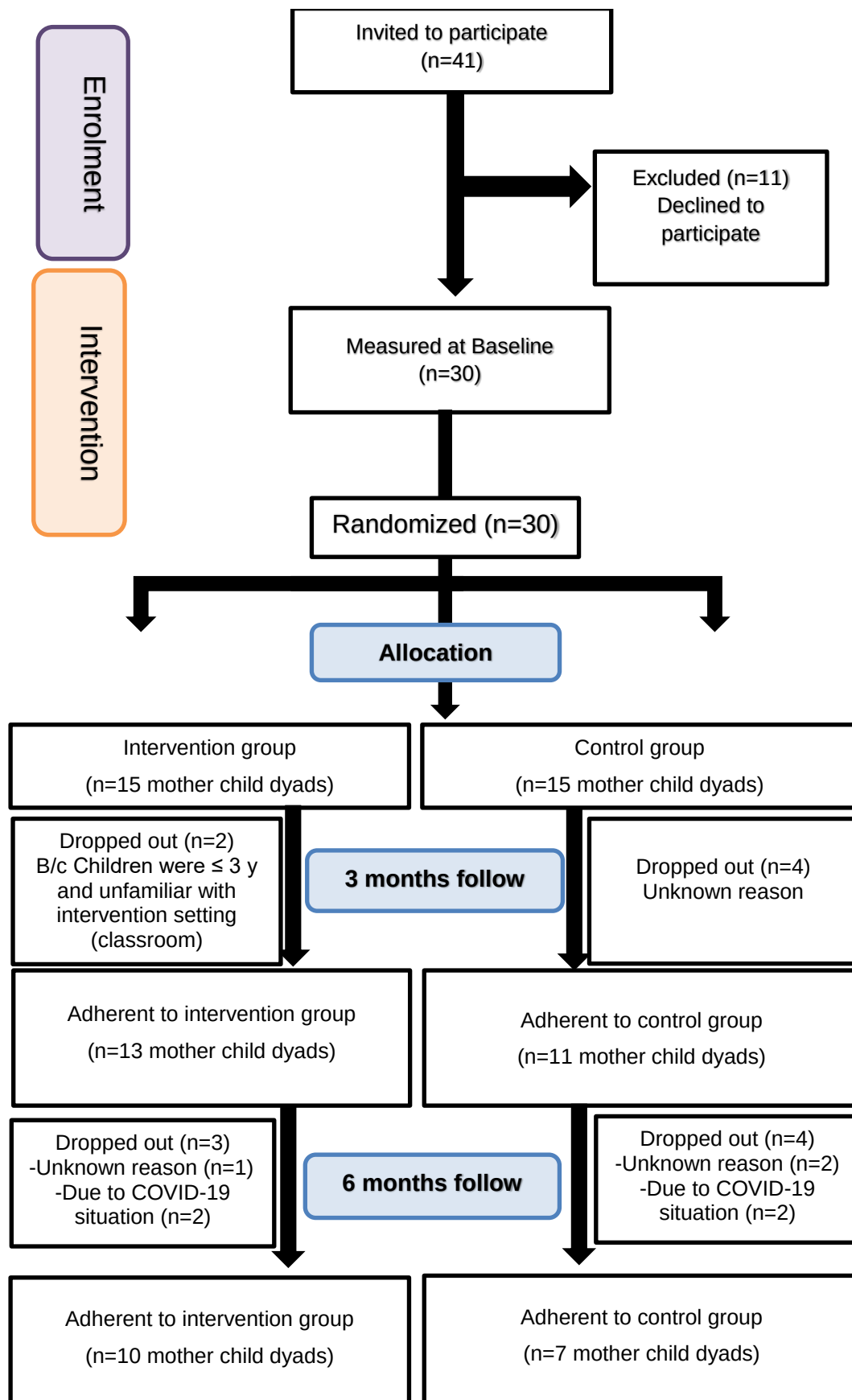
Figure 9-1 Participant Flow through the pilot RCT

Figure 9-2 Thematic analysis of mothers' feedback on the intervention

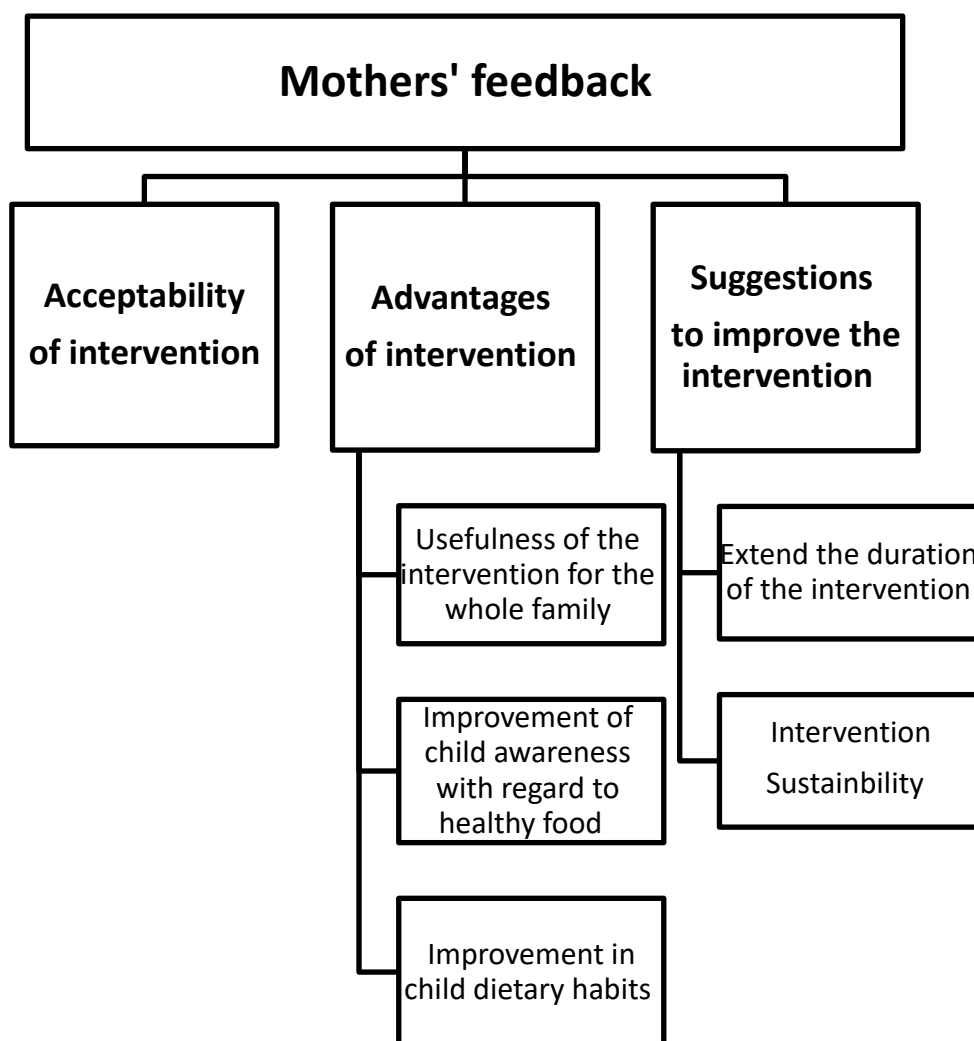


Figure 9-3 Representative quotes of the first theme: Acceptability of intervention

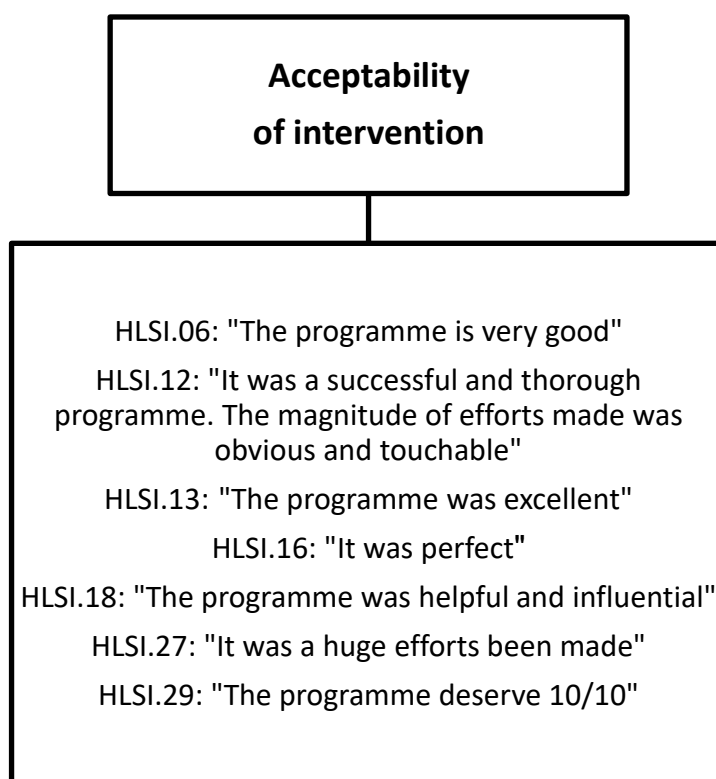


Figure 9-4 Representative quotes for the second theme : intervention advantages

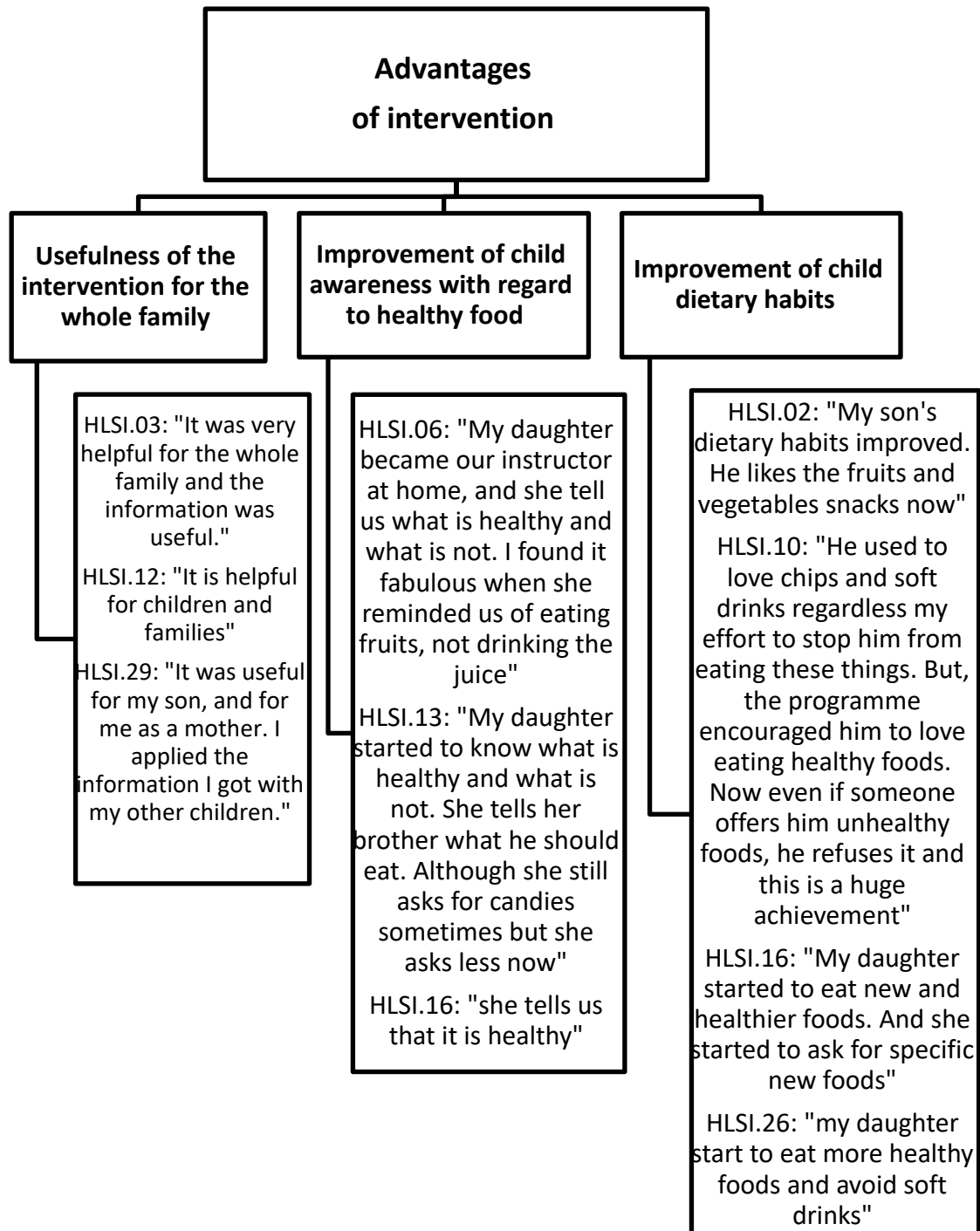


Figure 9-5 Representative quotes for the third theme: suggestions to improve the intervention in the future

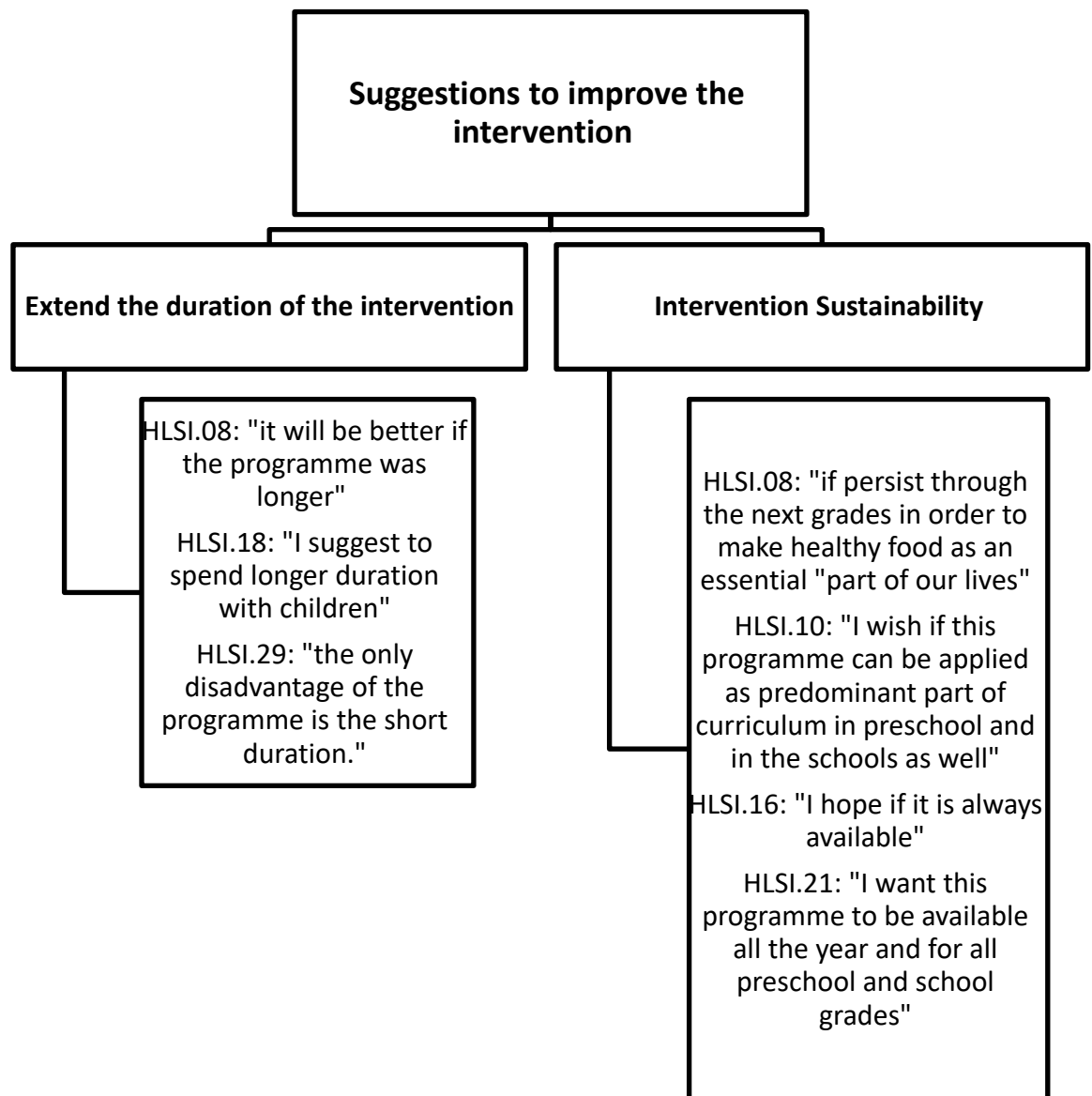


Table 9-1 Sociodemographic data of study participants at baseline

		All		Intervention		Control		p ¹	Comparison data	
		n=30		n=15		n=15			National/published	
Child										
	Age, years	4.5	(1.0)	4.4	(1.0)	4.6	(0.9)	0.5	-	
	Sex, Male, % (n)	43.3	(13.0)	33.3	(5.0)	53.0	(8.0)	0.4	50.9 ^a	50.5 ^b
	Nationality, Saudi, % (n)	100.0	(30.0)	100.0	(15.0)	100.0	(15.0)	-	79.2 ^a	80.2 ^c
Mother										
	Age, years	33.3	(7.2)	32.3	(7.2)	33.7	(7.5)	0.5	-	
	Education; with a degree, % (n)	70.0	(21.0)	73.3	(11.0)	66.7	(10.0)	0.6	25.4 ^d	54.0 ^e
Father										
	Education; with a degree, % (n)	73.3	(22.0)	66.7	(10.0)	80.0	(12.0)	0.4	28.1 ^d	62.2 ^e
	Social Class; non-manual, % (n)	100.0	(30.0)	100.0	(15.0)	100.0	(15.0)	-	-	90.0 ^e

Data are mean and (SD) unless indicated.

¹ Comparison between groups using independent t-test for continuous normally distributed variables and Chi-squared for categorical variables.

^a Data from Saudi Arabian General Authority for Statistics (2018) (917), ^b Data from El Mouzan et al. (2010) (410), ^c Data from Mesawa et al. (2020) (431), ^d Data from Saudi Arabian General Authority for Statistics (2017) (744) and ^e Data from Darwish et al. (2014) (449).

Table 9-2 Anthropometric measurements of study participants at baseline

		All n=30		Intervention n=15		Control n=15		p ¹
Child								
	Weight, kg	21.8	(4.2)	21.6	(4.8)	21.9	(3.7)	0.8
	Height, cm	108.1	(6.6)	108.0	(7.7)	108.3	(5.6)	0.8
	BMI, kg/m ²	18.5	(2.5)	18.4	(2.8)	18.7	(2.3)	0.7
	BMI z-score ²	1.5	(1.0)	1.4	(1.2)	1.6	(0.8)	0.6
Mother								
	Weight, kg	68.8	(10.3)	70.2	(10.3)	67.4	(10.5)	0.4
	Height, cm	159.3	(7.3)	160.9	(7.0)	157.6	(7.3)	0.2
	BMI, kg/m ²	27.1	(3.6)	27.1	(4.0)	27.0	(3.4)	0.9

All data are mean and (SD).

¹ Comparison between groups using independent t-test.

² BMI z-score estimated according to the WHO growth standards (2006), and WHO growth reference (2007).

Table 9-3 Home environment and lifestyle characteristics¹ of children at baseline

	All n=30		Intervention n=15		Control n=15		P ²
Home environment							
Inside playroom/area, % (n)	80.0	(24.0)	86.7	(13.0)	73.3	(11.0)	0.3
Outside play-area/yard, % (n)	56.7	(17.0)	60.0	(9.0)	53.3	(8.0)	0.7
Transportation							
Walk, ³ % (n)	36.7	(11.0)	33.3	(5.0)	40.0	(6.0)	0.7
Screen Time ³							
<60 min/day, %(n)	50.0	(15.0)	46.7	(7.0)	53.3	(8.0)	0.7
>60 min/day, %(n)	50.0	(15.0)	53.3	(8.0)	46.7	(7.0)	0.7
Physical activity ⁴							
<60 min/day, %(n)	43.3	(13.0)	53.3	(8.0)	33.3	(5.0)	0.2
>60 min/day, %(n)	56.7	(17.0)	46.7	(7.0)	66.7	(10.0)	0.2

Data are numbers and (%).

¹ Assessment of home environment and physical and sedentary behaviours using modified questionnaire based on Raynor et al., (2008) and Alturki, Brookes and Davies (2018).

² Comparison between groups using independent t-test for normally distributed variables and Chi-squared for categorical variables

³ Using walking for transportation in addition to a car.

⁴ Self- reported total daily time spent on sedentary behaviour, such as colouring, reading, listening to music and singing, sitting and playing with dolls.

⁵ Total daily time spent on screen including watching TV using smart devices and playing computer games.

⁶ Total daily time spent on playing actively either inside or outside home

Table 9-4 Parental feeding style and child eating behaviour at baseline

	All n=30		Intervention n=15		Control n=15		p ¹
Parental feeding style ²							
Instrumental feeding (IF) ³	3.1	(0.1)	3.0	(1.0)	3.3	(0.9)	0.4
Control (C) ⁴	3.3	(0.5)	3.3	(0.5)	3.2	(0.5)	0.7
Emotional feeding (EF) ⁵	2.4	(0.9)	2.4	(0.6)	2.3	(1.1)	0.7
Encouragement (EN) ⁶	4.0	(0.5)	4.1	(0.4)	3.9	(0.5)	0.5
Child eating behaviour/(Appetite traits) ⁷							
Food responsiveness (FR) ⁸	3.4	(0.9)	3.2	(0.7)	3.5	(1.1)	0.2
Emotional over-eating (EOE) ⁸	3.2	(1.0)	3.2	(1.2)	3.1	(0.9)	0.7
Enjoyment of food (EF) ⁸	3.6	(0.8)	3.7	(0.7)	3.5	(0.9)	0.5
Desire to drink (DD) ⁸	3.5	(0.8)	3.5	(0.8)	3.4	(0.9)	0.7
Satiety responsiveness (SR) ⁹	2.7	(0.8)	2.7	(0.8)	2.6	(0.6)	0.7
Slowness in eating (SE) ⁹	2.8	(0.8)	2.9	(0.9)	2.6	(0.6)	0.2
Emotional under-eating (EUE) ⁹	3.2	(0.7)	3.2	(0.7)	3.2	(0.7)	0.9
Food fussiness (FF) ⁹	2.8	(0.7)	2.8	(0.6)	2.7	(0.9)	0.7

All data are mean and (SD). ¹ Comparison between groups using independent t-test. ² Parental feeding styles was assessed using the questionnaire in Wardle et.al, 2002. Scores were measured on a continuous scale of 0-5 points. ³ providing food as a reward. ⁴ imposing control over a child eating. ⁵ The management of the child's mood and behaviour by providing food. ⁶ Providing encouragement to the child to eat. ⁷ Child eating behaviour was assessed using the questionnaire in Wardle et.al (2001). ⁸ Food approach appetite traits. ⁹ Food avoidant appetite traits.

Table 9-5 Food preferences¹ of children at baseline

	All n=30		Intervention n=15		Control n=15		p²
Carbohydrate preference score	3.8	(0.5)	3.7	(0.6)	3.7	(0.4)	0.7
Fruits preference score	3.7	(0.4)	3.7	(0.4)	3.6	(0.5)	0.6
Vegetables preference score	2.8	(0.5)	2.7	(0.4)	2.9	(0.5)	0.3
Dairy preference score	3.0	(0.6)	3.0	(0.5)	2.9	(0.8)	0.6
Meat preference score	3.3	(0.7)	3.3	(0.7)	3.2	(0.7)	0.5
Snacks preference score	3.9	(0.4)	4.0	(0.4)	3.9	(0.4)	0.6
Fast Food preference score	3.8	(0.7)	3.7	(0.7)	3.9	(0.8)	0.5

All data are mean and (SD).

¹ Food preferences were assessed using modified questionnaire by Fildes et al. (2014). Scores were measured on continuous scale of 0-5 points.

² Comparison between groups using independent t-test.

Table 9-6 Frequency of food intake¹ and healthy plate variety score² of children at baseline

	All n=30		Intervention n=15		Control n=15		p ³
Carbohydrate							
Daily serving ¹	4.7	(1.2)	4.9	(0.8)	4.6	(1.6)	0.5
Group score ²	0.7	(0.1)	0.7	(0.1)	0.6	(0.2)	0.5
Fruits							
Daily serving ¹	1.3	(0.6)	1.3	(0.7)	1.3	(0.5)	0.7
Group score ²	0.7	(0.5)	0.7	(0.6)	0.6	(0.5)	0.7
Vegetables							
Daily serving ¹	1.0	(0.1)	0.8	(1.0)	1.2	(1.1)	0.4
Group score ²	0.3	(0.3)	0.2	(0.3)	0.4	(0.3)	0.4
Dairy							
Daily serving ¹	1.4	(0.8)	1.5	(0.7)	1.4	(1.0)	0.8
Group score ²	0.5	(0.2)	0.5	(0.2)	0.4	(0.3)	0.8
Meat							
Daily serving ¹	1.7	(0.9)	1.7	(0.9)	1.6	(0.9)	0.6
Group score ²	0.8	(0.4)	0.8	(0.4)	0.8	(0.4)	0.6
Healthy plate variety score ²	2.8	(0.9)	2.8	(0.9)	2.7	(1.1)	0.9

All Data are mean and (SD). ¹ Food frequency intake was assessed using modified food frequency questionnaire by Jarman et al. (2014). ² Food group intake score and Healthy plate variety scores were assessed following the methodology described by Jones et al. (2015). ³ Comparison between groups using independent t-test.

Table 9-7 Comparison of anthropometry in randomised groups after intervention (3 months from baseline)

	Intervention n=13		Control n=11		Difference (unadjusted) ¹			Difference (adjusted) ²		
	Mean	SD	Mean	SD	Mean diff	(95%CI)	p	Mean diff	(95%CI)	p
Child										
Weight, kg	21.5	(4.6)	22.3	(0.4)	-0.8	(-4.5,2.9)	0.6	-0.4	(-1.0,0.1)	0.1
Weight, kg (change from baseline)	-0.2	(0.8)	0.2	(0.4)	-0.4	(-1.0,0.1)	0.1	-0.4	(-1.0,0.1)	0.1
BMI, kg/m ²	17.8	(2.2)	18.8	(2.4)	-1.0	(-3.0,0.9)	0.3	-0.3	(-0.7,0.2)	0.2
BMI (change from baseline)	-0.3	(0.7)	-0.1	(0.2)	-0.2	(-0.7,0.2)	0.2	-0.3	(-0.7,0.2)	0.2
BMI z-score ³	1.3	(1.0)	1.7	(0.9)	-0.4	(-1.2,0.4)	0.3	-0.06	(-0.3,0.2)	0.6
BMI z-score ³ (change from baseline)	-0.09	(0.4)	-0.06	(0.1)	-0.03	(-0.3,0.3)	0.8	-0.06	(-0.3,0.2)	0.6
Mother										
Weight, kg	67.8	(9.3)	65.7	(11.1)	2.1	(-6.2,10.5)	0.6	-0.8	(-1.9,0.2)	0.1
Weight, kg (change from baseline)	-1.3	(1.6)	-0.2	(1.0)	-1.1	(-2.3,0.1)	0.06	-0.8	(-1.9,0.2)	0.1
BMI, kg/m ²	26.2	(3.6)	26.7	(3.2)	-0.5	(-3.4,2.4)	0.7	-0.4	(-0.8,-0.1)	0.02
BMI, kg/m ² (change from baseline)	-0.5	(0.6)	-0.1	(0.4)	-0.4	(-0.8,0.1)	0.09	-0.4	(-0.8,-0.1)	0.02

¹ Comparison of randomised groups using independent t-test.

² Adjustment for baseline, age and sex using ANCOVA analysis.

³ BMI z-score estimated according to the WHO growth reference (2006-2007).

Table 9-8 Within subject change in anthropometry after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ¹		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Child									
Weight, kg	Intervention	13	21.7	(5.1)	21.5	(4.6)	-0.2	(-0.7,0.3)	0.3
	Control	11	22.1	(3.8)	22.3	(4.0)	0.2	(-0.1,0.5)	0.1
BMI, kg/m ²	Intervention	13	18.1	(2.6)	17.8	(2.2)	-0.3	(-0.8,0.1)	0.09
	Control	11	18.9	(2.2)	18.8	(2.4)	-0.1	(-0.3,0.1)	0.2
BMI z-score ²	Intervention	13	1.41	(1.1)	1.30	(1.1)	-0.09	(-0.3,0.1)	0.4
	Control	11	1.77	(0.8)	1.71	(0.9)	-0.06	(-0.1,0.04)	0.1
Mother									
Weight, kg	Intervention	13	69.1	(10.7)	67.8	(9.3)	-1.3	(-2.3,-0.3)	0.02
	Control	11	65.9	(10.2)	65.7	(10.2)	-0.2	(-0.9,0.5)	0.5
BMI, kg/m ²	Intervention	13	26.7	(4.1)	26.2	(3.6)	-0.5	(-0.9,-0.1)	0.02
	Control	11	26.8	(3.3)	26.7	(3.4)	-0.1	(-0.3,0.2)	0.5

¹ Testing within-Subject change using Paired t-test.

² BMI z-score estimated according to the WHO growth reference (2006-2007).

Table 9-9 Comparison of anthropometry in randomised groups at 6 months from the end of the intervention

	Intervention n=10		Control n=7		Difference (unadjusted) ¹			Difference (adjusted) ²		
	Mean	SD	Mean	SD	Mean diff	(95%CI)	p	Mean diff	(95%CI)	p
Child										
Weight, kg	22.3	(4.6)	21.8	(3.9)	0.5	(-4.1,0.51)	0.8	-0.4	(-1.2,0.4)	0.3
Weight, kg (change from baseline)	0.1	(0.7)	0.6	(0.8)	-0.5	(-1.3,0.3)	0.2	-0.4	(-1.2,0.4)	0.3
BMI, kg/m ²	18.1	(2.2)	19.1	(2.7)	-1.0	(-3.5,1.6)	0.4	-0.3	(-1.1,0.4)	0.3
BMI, kg/m ² (change from baseline)	-0.3	(0.6)	0.0	(0.6)	-0.3	(-1.0,0.2)	0.2	-0.3	(-1.1,0.4)	0.3
BMI z-score ³	1.5	(1.0)	1.8	(1.1)	-0.3	(-1.4,0.8)	0.5	-0.08	(-0.4,0.2)	0.6
BMI z-score ³ (change from baseline)	-0.09	(0.3)	0.0	(0.3)	-0.09	(-0.4,0.2)	0.5	-0.08	(-0.4,0.2)	0.6
Mother										
Weight, kg	70.0	(10.3)	64.7	(6.2)	5.3	(-4.1,14.6)	0.2	-0.6	(-1.9,0.6)	0.2
Weight, kg (change from baseline)	-1.2	(0.7)	0.2	(0.7)	-1.4	(-2.9,0.1)	0.06	-0.6	(-1.9,0.6)	0.2
BMI, kg/m ²	26.9	(4.0)	26.6	(3.4)	0.3	(-3.7,4.2)	0.9	-0.5	(-0.9,-0.01)	0.04
BMI, kg/m ² (change from baseline)	-0.4	(0.7)	0.1	(0.3)	-0.5	(-1.2,0.1)	0.07	-0.5	(-0.9,-0.001)	0.04

¹ Comparison of randomised groups using independent t-test.

² Adjustment for baseline, age and sex using ANCOVA analysis.

³ BMI z-score estimated according to the WHO growth reference (2006-2007).

Table 9-10 Within subject change in anthropometry at 6 months after the end of intervention

		Baseline			6 months follow-up		Within subject change ¹		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Child									
Weight, kg	Intervention	10	22.2	(5.1)	22.3	(4.6)	0.1	(-0.4,0.6)	0.5
	Control	7	21.2	(4.1)	21.8	(3.9)	0.6	(-0.1,1.4)	0.8
BMI, kg/m ²	Intervention	10	18.4	(2.4)	18.1	(2.2)	-0.3	(-0.7,0.1)	0.1
	Control	7	19.1	(2.6)	19.1	(2.7)	0.0	(-0.5,0.6)	0.9
BMI z-score ²	Intervention	10	1.62	(1.1)	1.53	(1.0)	-0.09	(-0.3,0.1)	0.3
	Control	7	1.8	(1.0)	1.8	(1.1)	0.0	(-0.3,0.3)	0.9
Mother									
Weight, kg	Intervention	10	71.2	(11.4)	70.0	(10.3)	-1.2	(-2.4,0.1)	0.06
	Control	7	64.5	(6.5)	64.7	(6.3)	0.2	(-0.4,.9)	0.4
BMI, kg/m ²	Intervention	10	27.3	(4.6)	26.9	(4.0)	-0.4	(-0.9,0.1)	0.07
	Control	7	26.5	(3.5)	26.6	(3.5)	0.1	(-0.1,0.3)	0.4

¹Testing within-Subject change using Paired t-test.

²BMI z-score estimated according to the WHO growth reference (2006-2007).

Table 9-11 Comparison of sedentary and active behaviours¹ in children between randomised groups after intervention (3 months from baseline)

	Intervention n=13		Control n=11		p ²
	%	n	%	n	
Screen Time³					
<60 min/day, %(n)	23.1	(3.0)	27.3	(3.0)	0.8
>60 min/day, %(n)	76.9	(10.0)	72.7	(8.0)	0.8
Physical activity⁴					
<60 min/day, %(n)	30.8	(4.0)	36.4	(4.0)	0.7
>60 min/day, %(n)	69.2	(9.0)	63.6	(7.0)	0.7

¹Assessment of sedentary and active behaviour of children using questionnaire by Raynor et al. (2008).

²Comparison of randomised groups using Chi-squared test.

³Screen time defined by watching TV.

⁴Time spent playing actively either inside or outside the home.

Table 9-12 Comparison of parental feeding style¹ in mothers between randomised groups after intervention (3 months from baseline)

	Intervention n=13		Control n=11		Difference (unadjusted) ²			Difference (adjusted) ³		
	Mean	SD	Mean	SD	Mean diff	(95%CI)	p	Mean diff	(95%CI)	p
Instrumental feeding⁴	2.5	(0.5)	3.2	(0.3)	-0.7	(-1.1,0.3)	0.001	-0.7	(-1.1,0.3)	0.001
Control feeding⁵	3.2	(0.4)	3.1	(0.3)	0.1	(-0.2,0.3)	0.7	0.0	(-0.2,0.3)	0.8
Emotional feeding⁶	2.3	(0.5)	2.4	(0.5)	-0.1	(-0.5,0.4)	0.8	-0.1	(-0.5,0.2)	0.4
Encouragement to eat⁷	4.0	(0.2)	3.9	(0.4)	0.1	(-0.2,0.3)	0.5	0.0	(-0.2,0.3)	0.8

¹ Parental feeding style was assessed using questionnaire by Wardle et al. (2002). Scores were measured on continuous scale of 0-5 points

² Comparison of randomised groups using independent t-test.

³ Adjustment for baseline and age using ANCOVA analysis.

⁴ Refers to providing food as a reward.

⁵ Refers to imposing control over a child eating.

⁶ Refers to the management of the child's mood and behaviour by providing food.

⁷ Refers to providing encouragement to the child to eat

Table 9-13 Within subject change in parental feeding style¹ in mothers after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ²		
		N	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Instrumental feeding³	Intervention	13	2.9	(1.0)	2.5	(0.5)	-0.4	(-0.9,0.1)	0.1
	Control	11	3.3	(0.9)	3.2	(0.3)	-0.1	(-0.8,0.7)	0.9
Control feeding⁴	Intervention	13	3.3	(0.5)	3.2	(0.4)	-0.1	(-0.3,0.2)	0.6
	Control	11	3.2	(0.6)	3.1	(0.3)	-0.1	(-0.3,0.3)	0.9
Emotional feeding⁵	Intervention	13	2.5	(0.6)	2.3	(0.6)	-0.2	(-0.5,0.1)	0.1
	Control	11	2.3	(1.0)	2.4	(0.5)	0.1	(-0.4,0.5)	0.8
Encouragement to eat⁶	Intervention	13	4.0	(0.4)	4.0	(0.2)	0.0	(-0.3,0.2)	0.7
	Control	11	3.9	(0.6)	3.9	(0.4)	0.0	(-0.2,0.3)	0.7

¹ Parental feeding style was assessed using questionnaire by Wardle et al. (2002). Scores were measured on continuous scale of 0-5 points.

² Testing within-Subject change using Paired t-test.

³ Refers to providing food as a reward.

⁴ Refers to imposing control over a child eating.

⁵ Refers to the management of the child's mood and behaviour by providing food.

⁶ Refers to providing encouragement to the child to eat.

Table 9-14 Comparison of child eating behaviour¹ between randomised groups after intervention (3 months from baseline)

	Intervention n=13		Control n=11		Difference (unadjusted) ²			Difference (adjusted) ³		
	Mean	SD	Mean	SD	Mean diff	(95%CI)	p	Mean diff	(95%CI)	p
Food responsiveness (FR)⁴	3.4	(0.6)	3.7	(0.7)	-0.3	(-0.8,0.1)	0.1	-0.1	(-0.3,0.2)	0.5
Emotional over-eating (EOE)⁴	3.3	(0.9)	3.1	(0.8)	0.2	(-0.6,0.9)	0.6	-0.1	(-0.4,0.2)	0.4
Enjoyment of food (EF)⁴	3.8	(0.5)	3.5	(0.6)	0.3	(-0.1,0.7)	0.1	0.2	(-0.1,0.4)	0.2
Desire to drink (DD)⁴	3.3	(0.5)	3.4	(0.5)	-0.1	(-0.5,0.4)	0.8	-0.2	(-0.5,0.2)	0.4
Satiety responsiveness (SR)⁵	2.8	(0.5)	2.6	(0.5)	0.2	(-0.2,0.7)	0.2	0.1	(-0.1,0.3)	0.3
Slowness in eating (SE)⁵	2.9	(0.9)	2.5	(0.5)	0.4	(-0.3,1.0)	0.2	0.1	(-0.1,0.3)	0.5
Emotional under-eating (EUE)⁵	3.1	(0.5)	3.2	(0.7)	-0.1	(-0.6,0.4)	0.6	-0.1	(-0.4,0.2)	0.5
Food Fussiness (FF)⁵	2.7	(0.6)	2.7	(0.7)	-0.0	(-0.5,0.5)	0.9	-0.1	(-0.3,0.04)	0.1

¹ Child eating behaviour was assessed using questionnaire by Wardle et al. (2001), Scores were measured on continuous scale of 0-5 points.

² Comparison of randomised groups using independent t-test.

³ Adjustment for baseline, age and sex using ANCOVA analysis.

⁴ Food approach traits.

⁵ Food avoidant traits.

Table 9-15 Within subject change in eating behaviour¹ in children after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ²		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Food responsiveness (FR)³	Intervention	13	3.4	(0.7)	3.4	(0.6)	0.0	(-0.2,0.03)	0.5
	Control	11	3.8	(0.8)	3.7	(0.7)	-0.1	(-0.2,0.1)	0.5
Emotional over-eating (EOE)³	Intervention	13	3.4	(1.1)	3.3	(0.9)	-0.1	(-0.2,0.1)	0.7
	Control	11	3.0	(0.6)	3.1	(0.8)	0.1	(-0.1,0.3)	0.4
Enjoyment of food (EF)³	Intervention	13	3.7	(0.7)	3.8	(0.5)	0.1	(-0.1,0.2)	0.5
	Control	11	3.5	(0.9)	3.5	(0.6)	0.0	(-0.3,0.4)	0.8
Desire to drink (DD)³	Intervention	13	3.6	(0.8)	3.3	(0.5)	-0.3	(-0.6,0.1)	0.08
	Control	11	3.3	(0.9)	3.4	(0.5)	0.1	(-0.4,0.5)	0.9

¹ Child eating behaviour was assessed using questionnaire by Wardle et al. (2001), Scores were measured on continuous scale of 0-5 points.

² Testing within-Subject change using Paired t-test.

³ Food approach traits.

Table 9-16 Within-subject change in eating behaviour¹ in children after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ²		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Satiety responsiveness (SR)³	Intervention	13	2.8	(0.7)	2.8	(0.7)	0.0	(-0.1,0.2)	0.6
	Control	11	2.6	(0.5)	2.6	(0.5)	0.0	(-0.2,0.1)	0.8
Slowness in eating (SE)³	Intervention	13	2.9	(0.9)	2.9	(0.9)	0.0	(-0.1,0.2)	0.4
	Control	11	2.5	(0.6)	2.5	(0.5)	0.0	(-0.2,0.2)	0.8
Emotional under-eating (EUE)³	Intervention	13	3.2	(0.7)	3.2	(0.5)	0.0	(-0.3,0.1)	0.6
	Control	11	3.2	(0.6)	3.2	(0.7)	0.0	(-0.2,0.3)	0.7
Food Fussiness (FF)³	Intervention	13	2.7	(0.6)	2.7	(0.6)	0.0	(-0.1,0.1)	0.3
	Control	11	2.6	(0.8)	2.7	(0.8)	0.1	(-0.1,0.2)	0.2

¹ Child eating behaviour was assessed using questionnaire by Wardle et al. (2001), Scores were measured on continuous scale of 0-5 points.

² Testing within-Subject change using Paired t-test.

³ Food avoidant traits.

Table 9-17 Comparison of food preference¹ between randomised groups in children after intervention (3 months from baseline)

	Intervention n=13		Control n=11		Difference (unadjusted) ²			Difference (adjusted) ³		
	Mean	SD	Mean	SD	Mean diff	(95%CI)	p	Mean diff	(95%CI)	p
Carbohydrate preference score	3.8	(0.2)	3.9	(0.4)	-0.1	(-0.3,0.2)	0.5	-0.1	(-0.2,0.1)	0.6
Fruits preference score	3.9	(0.6)	3.6	(0.5)	0.3	(-0.2,0.7)	0.2	0.1	(-0.3,0.5)	0.7
Vegetables preference score	3.0	(0.4)	2.9	(0.5)	0.1	(-0.2,0.5)	0.4	0.1	(-0.1,0.4)	0.1
Dairy preference score	3.2	(0.6)	3.0	(0.7)	0.2	(-0.3,0.7)	0.5	0.0	(-0.4,0.5)	0.8
Meat preference score	3.4	(0.6)	3.2	(0.7)	0.2	(-0.3,0.8)	0.3	-0.1	(-0.2,0.1)	0.5
Snacks preference score	3.9	(0.4)	4.0	(0.2)	-0.1	(-0.4,0.2)	0.4	-0.1	(-0.4,0.2)	0.5
Fast Food preference score	3.7	(0.6)	3.9	(0.6)	-0.2	(-0.7,0.3)	0.5	-0.0	(-0.4,0.3)	0.8

¹ Food preferences were assessed using modified questionnaire by Fildes et al. (2014). Scores were measured on continuous scale of 0-5 points.

² Comparison of randomised groups using independent t-test.

³ Adjustment for baseline, age and sex using ANCOVA analysis.

Table 9-18 Within subject change in food preferences¹ in children after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ²		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Carbohydrate preference score	Intervention	13	3.8	(0.6)	3.8	(0.3)	0.0	(-0.2,0.4)	0.7
	Control	11	3.8	(0.4)	3.9	(0.4)	0.1	(-0.01,0.2)	0.1
Fruits preference score	Intervention	13	3.8	(0.4)	3.9	(0.6)	0.1	(-0.2,0.4)	0.6
	Control	11	3.6	(0.4)	3.6	(0.5)	0.0	(-0.1,0.1)	0.5
Vegetables preference score	Intervention	13	2.8	(0.3)	3.0	(0.4)	0.2	(-0.01,0.4)	0.05
	Control	11	2.9	(0.4)	2.9	(0.5)	0.0	(-0.1,0.1)	0.4
Dairy preference score	Intervention	13	3.1	(0.5)	3.2	(0.6)	0.1	(-0.2,0.5)	0.4
	Control	11	2.9	(0.9)	3.0	(0.7)	0.1	(-0.1,0.5)	0.1
Meat preference score	Intervention	13	3.5	(0.6)	3.4	(0.6)	-0.1	(-0.1,0.1)	0.4
	Control	11	3.2	(0.8)	3.2	(0.7)	0.0	(-0.1,0.2)	0.5
Snacks preference score	Intervention	13	4.0	(0.4)	3.9	(0.4)	-0.1	(-0.4,0.1)	0.2
	Control	11	4.1	(0.3)	4.0	(0.2)	-0.1	(-0.2,0.1)	0.3
Fast Food preference score	Intervention	13	3.8	(0.7)	3.8	(0.6)	0.0	(-0.3,0.4)	0.8
	Control	11	4.0	(0.7)	3.9	(0.6)	-0.1	(-0.2,0.1)	0.3

¹ Food preferences were assessed using modified questionnaire by Fildes et al. (2014). Scores were measured on continuous scale of 0-5 points. ²Testing within-Subject change using Paired t-test.

Table 9-19 Comparison of food frequency intake¹ and healthy plate variety score² in children after intervention (3 months from baseline)

	Intervention n=13		Control n=11		Difference (unadjusted) ³			Difference (adjusted) ⁴		
	Mean	SD	Mean	SD	Mean diff	(95%CI)	P	Mean diff	(95%CI)	p
Carbohydrate										
Daily serving ¹	4.7	(0.7)	4.9	(1.5)	-0.2	(-1.2,0.7)	0.6	-0.3	(-0.9,0.2)	0.2
Group score ²	0.7	(0.1)	0.7	(0.2)	-0.0	(-0.1,0.1)	0.6	-0.1	(-0.1,0.03)	0.2
Fruits										
Daily serving ¹	1.8	(0.5)	1.2	(0.3)	0.6	(0.2,1.0)	0.005	0.5	(0.1,0.9)	0.01
Group score ²	0.9	(0.2)	0.6	(0.1)	0.3	(0.1,0.5)	0.005	0.2	(0.1,0.4)	0.01
Vegetables										
Daily serving ¹	1.7	(0.3)	1.0	(0.8)	0.7	(0.1,1.2)	0.01	0.6	(0.1,1.1)	0.008
Group score ²	0.6	(0.1)	0.3	(0.2)	0.3	(-0.7,0.6)	0.01	0.2	(0.1,0.3)	0.008
Dairy										
Daily serving ¹	1.8	(0.4)	1.1	(0.2)	0.7	(0.3,1.1)	0.001	0.6	(0.3,1.0)	0.001
Group score ²	0.6	(0.1)	0.3	(0.1)	0.3	(0.1,0.3)	0.001	0.2	(0.1,0.3)	0.001
Meat										
Daily serving ¹	1.5	(0.5)	1.4	(0.5)	0.1	(-0.7,0.6)	0.6	-0.1	(-0.4,0.1)	0.3
Group score ²	0.8	(0.2)	0.7	(0.2)	0.1	(-0.1,0.3)	0.6	-0.1	(-0.2,0.1)	0.3
Healthy plate variety score²	3.4	(0.3)	2.7	(0.6)	0.7	(0.2,1.4)	0.005	0.4	(0.1,0.8)	0.01

¹ Food frequency intake was assessed using modified food frequency questionnaire by Jarman et al. (2014).

² Food group intake score and HPVS were assessed following the methodology described by Jones et al. (2015).

³ Comparison of randomised groups using independent t-test.

⁴ Adjustment for baseline, age and sex using ANCOVA analysis.

Table 9-20 Within subject change in food frequency intake¹ in children after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ²		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Carbohydrate daily servings	Intervention	13	4.9	(0.9)	4.7	(0.7)	-0.2	(-0.6,0.2)	0.3
	Control	11	4.7	(1.7)	4.9	(1.5)	0.2	(-0.3,0.8)	0.4
Fruits daily servings	Intervention	13	1.4	(0.7)	1.8	(0.5)	0.4	(-0.1,0.9)	0.08
	Control	11	1.2	(0.3)	1.2	(0.3)	-0.0	(-0.4,0.7)	0.9
Vegetables daily servings	Intervention	13	1.1	(1.0)	1.7	(0.2)	0.6	(0.04,1.3)	0.04
	Control	11	0.9	(1.0)	1.0	(0.8)	0.1	(-0.1,0.4)	0.3
Dairy daily servings	Intervention	13	1.7	(0.6)	1.8	(0.4)	0.1	(-0.2,0.5)	0.2
	Control	11	1.2	(1.0)	1.1	(0.2)	-0.1	(-0.8,0.5)	0.5
Meat daily servings	Intervention	13	1.7	(0.9)	1.5	(0.5)	-0.2	(-0.6,0.1)	0.2
	Control	11	1.3	(0.7)	1.4	(0.5)	0.1	(-0.1,0.4)	0.3

¹ Food frequency intake was assessed using modified food frequency questionnaire by Jarman et al. (2014).

² Testing within-Subject change using Paired t-test.

Table 9-21 Within subject change in food group intake scores and HPVS¹ in children after intervention (3 months from baseline)

		Baseline			End of intervention (after 3 months)		Within subject change ²		
		n	Mean	SD	Mean	SD	Mean change	(95%CI)	p
Carbohydrate group score	Intervention	13	0.7	(0.1)	0.7	(0.1)	0.0	(-0.1,0.03)	0.3
	Control	11	0.7	(0.2)	0.7	(0.2)	0.0	(-0.1,0.1)	0.4
Fruits group score	Intervention	13	0.7	(0.3)	0.9	(0.3)	0.2	(-0.03,0.4)	0.08
	Control	11	0.6	(0.1)	0.6	(0.1)	0.0	(-0.1,0.1)	0.9
Vegetables group score	Intervention	13	0.4	(0.3)	0.6	(0.1)	0.2	(0.03,0.4)	0.04
	Control	11	0.3	(0.3)	0.3	(0.2)	0.0	(-0.1,0.1)	0.3
Dairy group score	Intervention	13	0.5	(0.2)	0.6	(0.1)	0.1	(-0.1,0.1)	0.3
	Control	11	0.4	(0.3)	0.3	(0.1)	-0.1	(-0.2,0.1)	0.5
Meat group score	Intervention	13	0.8	(0.4)	0.8	(0.2)	-0.0	(-0.3,0.1)	0.2
	Control	11	0.6	(0.3)	0.7	(0.2)	0.1	(-0.1,0.2)	0.3
HPVS	Intervention	13	3.0	(0.9)	3.4	(0.3)	0.4	(-0.1,0.9)	0.08
	Control	11	2.4	(0.9)	2.7	(0.6)	0.3	(-0.1,0.7)	0.1

¹Food group intake score and HPVS were assessed following the methodology described by Jones et al. (2015).

²Testing within-Subject change using Paired t-test.

9.16 Discussion

The primary aim of this pilot RCT was to test the feasibility of implementing an obesity preventative intervention in the KSA. The methods involved in the intervention appeared to be acceptable, since adherence to the programme was high, with 83% of participants completing it. Questionnaires were completed by parents and objective measurements relating to children's weight and height were successfully collected. Conducting the intervention was safe and produced no adverse effects. Furthermore, there were no physical issues concerned with raising activity levels, and there were no concerns regarding issues that might affect the children's psychological wellbeing.

The intervention was feasible and acceptable. This is most probably because it was developed with the consideration of the social and ideological preferences of Saudi families. According to the literature, cultural sensitivity was identified to be of considerable importance in terms of designing a successful and acceptable intervention ⁽⁵³⁹⁾. In line with this, an umbrella review of 12 systematic reviews (with acceptable methodological quality) reported that interventions driven by user involvement (parents and educators) are of considerable importance to ensuring the acceptability of an intervention by the local population ⁽⁵¹⁹⁾.

The feasibility and acceptability of the Healthy Living study could be attributed to an appropriate cultural adaptation of the Trim Tots intervention. To increase the likelihood of acceptance, an exploratory visit to the KSA was carried out to investigate the possibility and the initial acceptability of conducting a lifestyle intervention in the KSA. A qualitative assessment was then carried out to obtain a better understanding of facilitators of and barriers to participation in such a lifestyle intervention in the region. Such an adaptation process was reported in recent research as being helpful ⁽⁹¹⁸⁾. For example, during the investigation process, the scheduling of appointments and sessions was reported to be a barrier for parents to engage in healthy lifestyle interventions. To address this, the parental component of the present intervention was transformed from face-to-face into e-Health formats through online media.

Previous research showed that such a transformation was reported to offer advantages in terms of convenience and accessibility in comparison to face-to-face interventions⁽⁹¹⁹⁾.

A secondary aim of the pilot study was to undertake a pilot RCT that would help inform feasibility of the intervention and testing its efficacy in a future larger RCT. The pilot trial could also help to inform the sample size for future efficacy trial. This was primarily tested by measuring the improvement in child BMI z-score immediately after the intervention (3 months from baseline). This is discussed in the following section.

Influence of Healthy Living intervention on child BMI z-score and obesity-related factors

The effect size of the intervention in term of the difference in BMI z-score between the randomised groups at the end of the programme was -0.06 points. Although the difference was not significant, this agrees with the findings of previous systematic reviews, in which the effect sizes of BMI z-score reduction ranged between -0.04 to -0.3 points⁽⁴⁸⁰⁻⁴⁸²⁾. Regardless the absence of significant differences in anthropometric measurements, improvements in other obesity-related outcomes were apparent. This included a significant increase in the Healthy Plate Variety Score (HPVS), which is considered a good proxy to estimate the variety of foods in accordance with the main food groups (fruits, vegetables, carbohydrates, dairy and meat)⁽⁹²¹⁾. In addition, the intervention resulted in improvements in parental feeding practices and higher consumption of fruits and vegetables in children of the intervention group compared to the control.

These findings tie in well with those of an umbrella review of 12 systematic reviews that looked at the influence of obesity preventative interventions targeting young children⁽⁵¹⁹⁾. It was reported that, although no significant changes in anthropometric measurements were shown according to these reviews, 8 reported an improvement in children's eating habits. Such improvements included a higher consumption of fruits and vegetables as well as a lower fat intake.

Time2bHealthy is an example of a similar intervention that had comparable results to the present study (Heathy Living intervention). Time2bHealthy was an 11-week online healthy lifestyle programme targeting the parents of preschool children. 86 Australian child-parent dyads were enrolled in the programme. At the end of the intervention, the children's BMI measurements did not differ between groups, but discretionary food intake decreased significantly in children in the intervention group compared to their counterparts in the control group ⁽⁶⁶⁴⁾. Another 6-week cluster randomized controlled trial targeting 306 preschool children (4-6 years) in Sri Lanka yielded similar findings ⁽⁹²²⁾. This intervention provided nutrition education sessions for children, as well as parental engagement by providing nutrition education and meal preparation sessions. As a result, children's knowledge of nutrition increased significantly in the intervention group compared to the control group; however, no significant change was reported for anthropometric outcomes ⁽⁹²²⁾.

Additional findings consistent with the present intervention results were reported by the HENRY programme (Health Exercise Nutrition for the Really Young). The HENRY programme is an 8-week community obesity preventative intervention in the UK, delivered mostly by staff in children's centres. The intervention aimed at improving parenting skills and family lifestyles, as well as the environment of the children's centre ⁽⁹²³⁾. 1,100 preschool children and their families took part in the programme. Data on anthropometric measurements were not collected, but fruits and vegetables intake increased significantly in both parents and children. The number of parents who met their 5-daily-portions of fruit and vegetables increased from 14% to 33%, and the percentage of children meeting the recommendation increased from 22% to 44% ⁽⁹²⁴⁾. Meanwhile, the consumption of high fat and sugary foods decreased in both parents and children ⁽⁹²⁴⁾.

Further consistent findings with the present study were reported by a study that adapted the US NASA Mission X-Based programme. This programme targeted 534 South Korean preschool children at 7 kindergartens. The programme focused on nutrition education. It was delivered by nutrition

professionals with the cooperation of class teachers who were taught how to provide the lessons plan. The intervention did not result in a significant change in anthropometric measurements, but fruit consumption improved in the intervention group compared to the control group ⁽⁹²⁵⁾.

As described above, many lifestyle interventions have been successful in improving healthy lifestyle measures. However, improvements in BMI z-score were rarely achieved. The reasons for the lack of effect on anthropometric measures is not known. But one possibility is that, while interventions improve healthy eating practices, these changes in behaviour will only lead to improvements in BMI z-score over a period of time and most studies are not of a long enough duration. This was raised by Mehdizadeh et al. (2020), who carried out a systematic review of obesity preventative interventions targeting preschool children. This review included 26 RCTs that were conducted over the last 10 years (2008-2018). The authors provided an explanation for the fact that half of studies in their review did not show a significant change in child BMI, although more than 70% of these studies were of a good standard. They speculated that changes in BMI may not be appropriate for detecting the efficacy of interventions because focusing on improving obesity related behaviour (e.g. diet, physical activity, parental feeding practices and environmental factors) may result in more reliable results on weight status over a sufficient adequate period of time ⁽⁶³⁷⁾.

Several factors may mediate the effectiveness of an intervention. This is supported by the conclusion of the authors of the most recent systematic review and meta-analysis which was conducted by Long et.al (2021). It investigated the efficacy of dietary interventions on weight outcomes. This review included 28 RCTs (of mixed qualities) lasting for up to one year, and targeted children aged ≤ 18 years. The pooled analysis showed a small, reduction in the child BMI z-score (-0.04 points) ⁽⁴⁸²⁾. However, this review reported that the duration of an intervention is one factor that may mediate effectiveness of dietary interventions. This highlights the fact that many studies could be hampered by the lack of sufficient duration and long-term follow up, obscuring any possible longer term conclusions ⁽⁵³⁹⁾. The section below

considers the potential factors that may influence the effectiveness of obesity preventative interventions.

Potential factors that could influence intervention effects on anthropometric measurements

There is insufficient evidence with regard to the optimal duration for intervention that could yield a significant change in children's anthropometric measurements of obesity. However, a systematic review of 12 family-based obesity preventative interventions, which targeted preschool children, indicated that a minimum of 12 weeks might be needed for intervention to be effective in reducing weight outcomes ⁽⁵³⁸⁾. Longer term interventions (≥ 1 year) could be associated with greater effect size, as indicated below ⁽⁶¹⁴⁾.

The effectiveness of longer duration programmes on improving anthropometric measurements was supported by many studies. Hu et al. (2017), for example, found that a duration of one-year for a multi-component intervention was associated with a significant reduction of BMI z-score (-0.3 points) in preschool children who were assigned to the intervention group compared to the control group ⁽⁵⁷³⁾. Additional supportive findings were reported by a study that lasted for 2 years. This study included 676 Norwegian children (2-7 years old) and provided parental counselling on healthy habits to address childhood overweight and obesity. After a duration of 2 years, children who were overweight at the start of the programme showed a significantly lower BMI z-score (≈ -0.3 points) ⁽⁹²⁶⁾.

Another supportive example of the impact of the longer duration interventions on the effect size includes a study that required a duration of 3 years to produce a significant reduction of BMI z-scores. This study investigated the effectiveness of a multi-component intervention that included 534 multi-ethnic preschool children along with their parents. After 3 years, the BMI z-score reduced (≈ 0.6 kg/m²) in Hispanic children assigned to the intervention group compared to their counterparts in the control group ⁽⁹²⁷⁾. Therefore, it may be that longer durations (i.e. 1 to 3 years) are needed for lifestyle interventions to produce a significant effect on anthropometric measurements. However, more

research is needed to identify the optimal duration for lifestyle intervention to result in a significant change of weight outcomes.

There is a debate whether such long-term interventions can be sustained. Interventions with shorter durations have shown sustained effects at follow-up. For instance, a systematic review and meta-analysis of 52 studies, of which 42 were RCTs, found that lifestyle interventions with median duration of 6 months was effective in reducing BMI in preschool children by approximately 0.2 kg/m² with sustained effect at follow-up ⁽⁴⁸⁰⁾. However, the follow-up for some studies was <12 months. The literature supports that interventions should have a follow-up for >12 months or even >2 years to sufficiently evaluate the intervention's sustainability or identify a delayed effect ⁽⁹²⁸⁻⁹²⁹⁾. Thus, more studies with sufficient follow-up duration are needed to draw clear conclusion with regard to long term interventions vs sustainability.

The effectiveness of interventions may also be dependent on the 'dose', according to a review conducted by Roseman, Riddell and McGee (2020) ⁽⁹³⁰⁾. Dose can be characterised by duration, frequency of sessions over intervention duration and length of such sessions ⁽⁶⁷³⁾. Connell, Turner and Mason (1985) had reported that although a few hours of intervention can raise nutrition knowledge in school children, a longer time (40-50 hours) is estimated to be required to significantly affect attitudes and practice ⁽⁹³¹⁾. Recommendations regarding the dose of interventions required to produce a significant effect on obesity-related outcomes are lacking for preschool children ⁽⁵³⁸⁾. This is because, the dose of interventions is not always reported in published studies. Hence, a lack of such information prevents drawing a clear conclusion on the recommended dose of successful obesity preventative interventions for preschool children ⁽⁹³⁰⁾. Therefore, future research to investigate the dose of the intervention and the components involved to bring about a positive result appears to be necessary ⁽⁵³⁹⁾.

According to the context explained above, the lack of effect of the Healthy Living intervention on children's BMI z-score may not only be attributable to its short duration (i.e. 3 months), but rather, to the adequacy of dose (amount) of the intervention. For example, inadequate physical activity in a city like

Makkah, where hot weather is a barrier to regular daily outside movement, may be a key contributor to obesity risk. The Healthy Living study only provided one 30-minute session of physical activity per week over 3 months (a total of 6 hours over the course of the intervention). Although the Healthy Living intervention provided mothers with suggestions to encourage their children to be more physically active, no significant difference was detected in terms of time spent on physical activity in the recruited sample. It is therefore might be helpful to increase the physical activity component in future studies targeting Saudi children.

The findings of the ToyBox intervention are in line with the suggestion that an insufficient physical activity component may explain the absence of BMI z-score reduction in Healthy Living study. The ToyBox intervention was a cluster randomized controlled trial implemented in kindergartens with family involvement. It aimed to reduce overweight and obesity rates in preschool children from 6 European countries via improving dietary habits and physical activity level. The physical activity component included 6 movement sessions at kindergartens and providing parents with newsletters that included tips on increasing physical activity at home. This intervention resulted in a significant reduction of prepacked fruit juice intake ⁽⁹³²⁾. However, it did not reduce the BMI z-score to a significant level. The authors suggested that the non-significant findings with regard to weight status outcomes could be attributed to the lack of sufficient physical activity in the intervention ⁽⁹³³⁾.

In contrast, a sufficient physical activity component of an intervention could play a role in improving anthropometric measurements. For instance, Join the Healthy Boat campaign was a multilevel multicomponent programme conducted in Germany that was aimed at preventing obesity in preschool children. This clustered, randomised and longitudinal study included 973 children from 57 kindergartens. Over the course of a year, children in the intervention group spent more days performing sufficient physical activity (a daily hour of moderate to vigorous physical activity). As a result, they had a significantly lower BMI percentile compared to their counterparts in the control group ⁽⁹³⁴⁾. Likewise, the AanTafel! multicomponent intervention, which

provided 22.5 contact hours of physical activity, resulted in a significant reduction in BMI z-score among Dutch children assigned to the intervention group compared to counterparts in a reference group over a course of one year ⁽⁶¹⁸⁾.

Other studies, however, do not support the above hypothesis. For instance, the Movement and Activity Glasgow Intervention in Children (MAGIC) ⁽⁵⁸²⁾, and the Mighty Moves programme ⁽⁵⁸³⁾ are examples of studies that focused on improving physical activity in preschool children, yet these programs were not effective in reducing child BMI. Therefore, more research is needed to identify the optimal dose of physical activity component to produce a significant difference in weight outcomes.

Additional explanation for the absence of significant difference in child BMI z-score after the end of Healthy Living intervention is that the study targeted the individual level, only. Using a multi-level programme could produce a more favourable effect in terms of reducing the rates of obesity in preschool children ⁽⁵¹⁹⁾. The findings of recent systematic review conducted by Narzisi and Simons (2021) are in line with this. The systematic review included 30 studies involving 23,185 preschool children from 9 countries. It indicated the effectiveness of multi-component, multi-level interventions that addressed eating habits, physical activity and environmental factors at a societal level, including the implementation of policies in childcare settings ⁽⁵³⁹⁾.

As described above, while the Healthy Living study did not result in significant difference in child BMI z-score, it was associated with improvements in dietary habits in children and parental feeding practices. It is possible that this could be attributed to distinct strategies used throughout the course of the programme. This is discussed in the following section.

Advantages of potential strategies used in Healthy Living intervention to improve lifestyle factors of Saudi preschool children

Apart from the non-significant reduction in BMI z-score, there was a significant improvement in dietary habits of children in the intervention group compared to the control group. This included a higher consumption of fruits and

vegetables. This improvement could be attributed to the engagement of children in snack preparation during the sessions held in the kindergarten. It was reported in the literature that engaging children in healthy meal preparation correlated positively with child preferences for vegetables ⁽⁹³⁵⁾ and a consequent higher consumption during preschool years ⁽⁹³⁶⁾.

A further explanation for the positive impact of the Healthy Living intervention on children's dietary habits could be that the intervention provided parents with a variety of techniques to improve their children's dietary habits. These included appropriate use of non-food reward and modelling healthy eating. Other techniques include repeated taste exposure, visual presentation and increasing the availability and accessibility of healthy foods in the home environment. Discussion of the included strategies and supporting evidence are provided below.

The Healthy Living study encouraged mothers to model healthy eating behaviours in front of their children. This might have encouraged children to eat healthier foods including increased consumption of fruits and vegetables. In line with this, effectiveness of modelling technique was supported by the findings of previous intervention that was aimed to improve parental reward and modelling behaviour. That intervention reported that fruits consumption increased by 50% and vegetables intake increased by 52% ⁽²⁸²⁾.

The Healthy living study also encouraged mothers to repeat exposure to rarely eaten healthy food. This might be an additional factor that promoted the improvement of children's dietary habits as a result of the intervention. It is suggested that repeating taste exposure helps in increasing familiarity with new foods and hence, increases acceptance ⁽⁹³⁷⁾. This is supported by a systematic review of 30 studies (weak to moderate quality). It was reported that repeated taste exposure (from 7 to 15 times) was associated with a higher intake and greater acceptance of vegetables ^(628; 903-904). Consistent with this, the effectiveness of repeated taste exposure strategy on increasing the consumption of vegetables was reported by the findings of a 5-week intervention. This study investigated 15-times repeated exposure to vegetables, and it was found that the daily vegetables intake increased

significantly (by almost the double) in children who participated in the intervention compared to those in the control group⁽⁹³⁸⁾.

In addition to the strategies mentioned above, the Healthy living study encouraged mothers to make healthy foods more accessible to children. It is possible that such a strategy may have contributed to the improvement of children dietary habits as a result of the intervention. This is consistent with the findings of the ToyBox study, which included 5,185 preschool children. It was reported that increasing the accessibility and availability of healthy snacks was associated with greater consumption of such healthy items in preschool children⁽⁹³⁹⁾.

It is important to note that previous effective interventions were implemented in diverse conditions and used different combinations of strategies. The effectiveness of each strategy cannot be evaluated separately. This is because such strategies cannot be isolated from each other. Consequently, that could possibly result in different interaction effects⁽⁶³⁶⁾. Therefore, further research is required to identify which techniques or combination of techniques are the most effective for obesity prevention in preschool children.

As well as the positive effect of the intervention on children's dietary habits, the process also resulted in a significant improvement in parental feeding styles. This is discussed in the section below.

Healthy Living intervention influence on maternal feeding practices

At the end of the Healthy Living study, mothers of children in the intervention group had lower rates of instrumental feeding behaviour than the mothers of children in the control group. This is an important finding, as the link between instrumental feeding and childhood overweight/obesity has been documented in previous research⁽²⁵⁸⁻²⁶¹⁾.

It is suggested that instrumental feeding could affect weight status indirectly by affecting other factors that could result in weight gain⁽⁹⁴⁰⁾. One possible mechanism, for example, is that instrumental feeding is associated with the use of food, which is usually palatable and high in calories, as a reward⁽²⁶²⁾.

This may raise the value of such food used as a reward in the child's mind and lead to a stronger preference for energy-dense foods ⁽²⁶³⁾ and a subsequent higher consumption of calories. This could also be associated with excessive weight gain. An example that supports such a hypothesis is the findings of a cross-sectional study that included 135 children aged between 6-7 years old. The study found a positive correlation between instrumental feeding and child snacking behaviour. That is, higher instrumental feeding scores were associated with a higher frequency of snacking ($p < 0.05$) ⁽⁹⁴¹⁾. In addition, a large-scale survey in Hong Kong that studied 4,553 preschool children aged between 2 and 5 years found that instrumental feeding was related to a significantly higher consumption of energy-dense snacks ⁽²⁶⁷⁾. An additional study, which included 644 parents, agrees with this finding. This study found that children of mothers who frequently used instrumental feeding had a 1.4 times higher risk of consuming less healthy snacks more than once a week compared to their counterparts, whose mothers relied less on instrumental feeding ⁽²⁵⁸⁾.

Other proposals include the idea that instrumental feeding may modify child eating behaviour by changing food approach traits, resulting in weight gain ⁽²⁶¹⁾. A cross-sectional study of 98 preschool children in Belgium, with a mean age of 4.9 years, reported that reward sensitivity was positively correlated to food approach traits ($\beta = 0.4$, $p < 0.001$), including food responsiveness and enjoyment of food ⁽²⁶⁵⁾. Another example to illustrate the possible impact of parental feeding practices on child eating behaviour is shown by the findings of a cross-sectional study of 435 preschool children (3-5 years) in the UK. This study reported that children of mothers with higher instrumental feeding scores had a significantly higher score in food responsiveness ($p < 0.001$) ⁽⁹⁴²⁾.

It is important to note that different ethnicities and cultural backgrounds could play a role in shaping parental feeding styles. This is supported by the findings of a cross-sectional study based on multi-ethnic population research in the Netherlands, which included 644 school-aged children. The study concluded that instrumental feeding scored highest in the Moroccan and Turkish sectors of the population, and lowest in the Dutch population ⁽²⁵⁸⁾. Additional supportive

examples include the findings of studies that compared parental feeding styles in different ethnic populations living in the UK. It was found that the South Asian population scored high in emotional feeding compared to the British population (810-811).

Other studies did not find an association between instrumental feeding and childhood obesity (943-946). These mixed findings could be explained by the factors of ethnicity mentioned above, which may in turn be linked to differences in the social constructs and cultural beliefs of the distinct populations. Thus, further investigation of the impact of parental feeding practices on child weight status among the different cultures is required.

Bearing in mind the potential adverse influence of inappropriate feeding style, the Healthy Living study educated mothers about parental feeding styles, and was successful in reducing instrumental feeding scores. Similar findings were reported by another intervention that provided healthy-behaviour counselling to the parents of preschool children with rapidly increasing BMI. Compared to baseline, that intervention was effective in reducing the instrumental feeding scale, as well as BMI z-scores in children within the intervention group (947). This highlights the importance of raising the level of awareness about feeding behaviour among parents.

The results of the Healthy Living intervention discussed above were measured after the intervention ended (3 months from baseline). However, it is worth noting that the effect on BMI z-score, though non-significant, was still maintained 6 months following intervention completion (9 months from baseline). This coincided with the national lockdown in the KSA. It is important to mention that the severity of COVID-19 was more than 9 times higher in patients with obesity compared to those with healthy weight range (OR=9.2, 95% CI 2.7 to 31.1; $p<0.001$) (948). This stresses on the importance of obesity prevention. The effectiveness of the intervention in terms of maintaining lower child BMI z-score and maternal BMI during the COVID-19 lockdown is discussed below.

Influence of Healthy Living intervention on anthropometric measurements at 6 months following intervention completion – During COVID-19 lockdown

It is promising that lower child BMI z-score in the intervention group compared to the control was maintained at 6 months following intervention completion, even in the Covid 19 lockdown. In contrast, other studies reported an adverse global impact of such lockdown on obesity related measures. For example, it was reported that sugary drinks, potato chips and the consumption of red meat increased significantly in Italian preschool children during the pandemic lockdown. Screen time also increased significantly, while physical activity decreased ⁽⁹⁴⁹⁾. The combination of these factors could result in weight gain. According to a study conducted in Greece, 35% of preschool children gained excess weight during the lockdown ⁽⁹⁵⁰⁾. Meanwhile, Kuwaiti adults who reported adopting less healthy dietary habits during the lockdown were 4.5 times more likely to gain excess weight compared to those who ate healthier foods ⁽⁹⁵¹⁾. Similar findings were reported in the KSA, in which Saudi adults were at 5-fold higher risk of developing obesity during the pandemic ⁽⁹⁵²⁾. It is promising that the Healthy Living intervention provided a way of preventing excess weight gain during a period in which sedentary behaviour and less healthy eating behaviours became prevalent.

It is suggested that supporting home resilience, as well as the emotional well-being of families during difficult times, such as the pandemic, is important. A recent qualitative study conducted by Nowicka et al. (2022) ⁽⁹⁵³⁾ looked at the change in dietary habits of preschool children, who participated previously in a weight management intervention, between the first and second waves of the pandemic. This study collected data from 3 European countries. It was reported that obesity-related behaviours of these children were influenced by the parental practices, which were, in turn, affected by their emotional and social well-being. For instance, a mother who had a secure job and stable life was able to manage her child's craving for food by offering healthy options, such as fruits and vegetables. In contrast, another mother who was

experiencing a form of stress and economic insecurity was not able to negotiate healthy eating options with her child when craving for food ⁽⁹⁵³⁾.

Apart from the effects on children's dietary habits and weight status, one interesting finding was that the Healthy Living intervention resulted in a significant reduction in the BMI of mothers by the end of the intervention. The significant difference was maintained after 6-month follow-up after the completion of the intervention. These findings verified the influential effect of lifestyle intervention on addressing overweight/obesity in participating parents. The Cochrane review, conducted by Colquitt et al. (2016) included 7 RCTs with a total of 923 participants, and confirmed a significant reduction in parental BMI of participants in the multicomponent interventions compared to parents in the control groups ⁽⁵³⁵⁾.

The behaviour change techniques introduced to parents throughout the intervention could be a crucial driver of significant BMI reduction in mothers in the intervention group. Ells et al. (2018) conducted an overview of 6 systematic Cochrane reviews in order to provide evidence of successful interventions in treating obesity. Behavioural change was the cornerstone of effective interventions as indicated by all 6 reviews. Both children and parents can benefit from such behaviour change techniques ⁽⁶³⁰⁾. More detail with regard to the potential impact of the integrated behaviour change techniques through the course of the Healthy Living intervention is provided below.

Potential beneficial effect of integrated behaviour change techniques in Healthy Living intervention on mothers' weight status

Mothers assigned to the intervention group of the Healthy Living study were taught how to set SMART goals (Specific, Measurable, Achievable, Relevant and Time limited) for themselves and for their children. There are distinct potential mechanisms linking goal setting process and successful behaviour change, which might have explained the significant reduction in mothers' weight. Firstly, the motivation for higher performance is likely to be generated using goal setting. This is the central idea of Goal Setting theory. Secondly, it is suggested that goal setting reduces distractions and encourages more

persistence in terms of reaching targets. Thirdly, goal setting is associated with the stimulation of cognitive functions, including the activation of strategic analysis functions, in which a person begins to break the target goal down into smaller parts that can be approached in a stepwise manner ⁽⁹⁵⁴⁾. An additional benefit of setting SMART goals can be attributed to their positive influence in raising self-esteem, which is associated with improvements in the process of behaviour change ⁽⁶⁸⁶⁾.

In addition to learning how to set SMART goals, parents were taught how to review the progress of achieving the goals they had set. This included identifying barriers and weighing the pros and cons of goal achievement. Previous research suggested that parents are more aware that the advantages of the new behaviour outweigh the disadvantages, and this leads to a positive attitude towards the targeted behaviour ⁽⁶⁹²⁾.

Another potential aspect of the intervention that may have facilitated weight reduction in mothers is providing them with healthy cooking tips and an air fryer. It is likely that providing them with the air fryer was helpful in terms of replacing traditional deep-frying and reduce added fat in meals. A higher intake of fat has been suggested to be associated with a higher BMI. Fat is the most energy dense macronutrient, providing ~9 kcals/gram, while protein and carbohydrate provide ~4 kcals/gram. It is therefore suggested that higher fat intakes will result in a positive energy balance, causing weight gain ⁽⁵⁹⁸⁾. Conversely, healthy cooking techniques have been associated with a significantly lower consumption of fat ⁽⁹⁵⁵⁾ and ultra-processed food ⁽⁹⁵⁶⁾, as well as the encouragement of healthy eating ⁽⁹¹⁸⁾. These aspects may have played a role in reducing the risk of overweight and obesity in mothers of children in the intervention group.

9.17 Chapter Summary

Childhood obesity has become a public health crisis in the KSA. However, interventions that targets preschool children and aim to address such an epidemic are not yet available in the region. Therefore, the current PhD project aimed to adapt the Trim Tots intervention, which was successful in reducing obesity in preschool children in the UK. The current intervention was developed in accordance with previous literature and the investigation of the risk factors of obesity in Saudi preschool children (Chapter 6). In addition, the intervention considered the enablers of and barriers to attending lifestyle interventions in the KSA that were described via initial PPI exercise and the qualitative data (Chapter 7). The adapted intervention was named the Healthy Living Study (Chapter 8).

As indicated by the current pilot RCT, the Healthy Living study was feasible and acceptable to the Saudi population probably because the intervention was adapted and took into account the cultural and social practices in KSA. Although the intervention did not reduce child BMI z-score significantly, it improved dietary habits of children and parental feeding styles. It is possible that longer duration of intervention implementation could reduce child BMI z-score. Interestingly, at the end of the intervention, maternal BMI was significantly reduced, even at 6 months following intervention completion. Also, BMI z-score in children of the intervention group was maintained to be lower than that in children of the control group, though the difference was not significant. The study provides the basis for a larger RCT to test the efficacy of the Healthy Living intervention in the wider preschool Saudi population.

10. Chapter 10: Overall Discussion and Conclusion

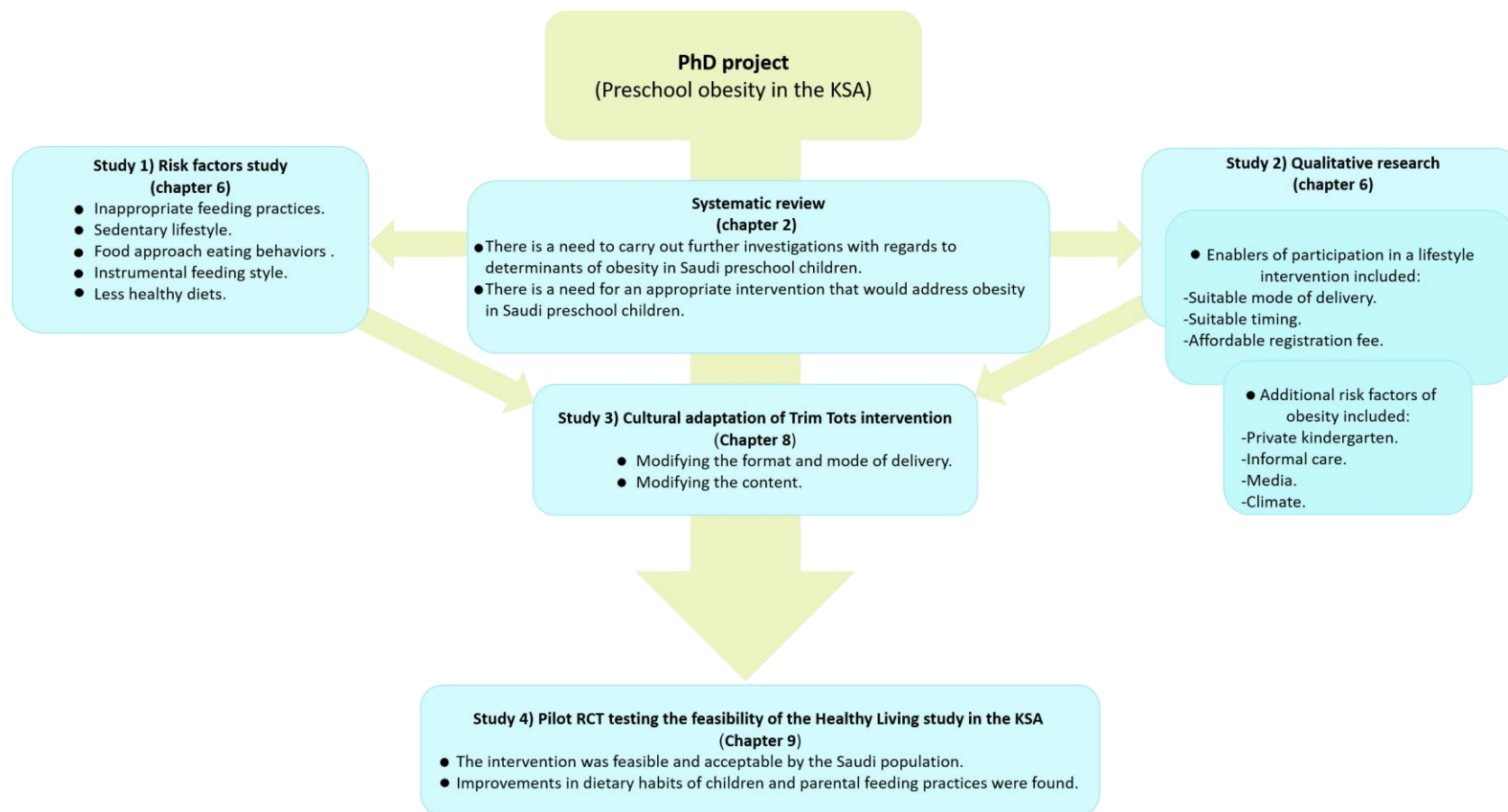
The KSA ranks among the world's top 10 countries for obesity prevalence. However, data with regard to obesity in preschool children are scarce. Thus, as part of this PhD project, I conducted a systematic review to describe the prevalence and the risk factors of obesity in young Saudi Arabian children, aged 0-6 years (Chapter 2). This systematic review identified 10 relevant studies and reported a high prevalence of childhood obesity in the region. It reported that studies on obesity determinants in young children are limited, and hence, more research is needed to inform the development of an appropriate intervention. Most importantly, the systematic review identified an absence of obesity preventative interventions in Saudi preschool children and their families as a gap in the literature. Therefore, the aims of this PhD project were to determine the risk factors of obesity in Saudi preschool children and to test the feasibility of conducting a preventative intervention in the KSA. To achieve these aims, four studies were completed.

The first study in this PhD project investigated the risk factors of obesity in Saudi Arabian preschool children (Chapter 6). The second study used qualitative research and carried out interviews with mothers, to gather in-depth information on the barriers to a healthy diet and lifestyle in the KSA, as well as the enablers of participation in a healthy lifestyle intervention (Chapter 7). The third study described the adaptation of the Trim Tots intervention, a healthy lifestyle programme that reduced obesity in preschool children living in the UK. The adaptation process aimed to develop an intervention that would suit the characteristics of the Saudi community (Chapter 8). The final study tested the feasibility of the adapted intervention (i.e. the Healthy Living study) through a pilot RCT conducted in the Hadekat Al-Tefl Kindergarten, in the Makkah region of the KSA (Chapter 9). Figure 10-1 illustrates a summary of the studies that were carried out as part of the current thesis, with a brief description of their main findings.

This chapter provides an overall discussion of this PhD project's findings. It starts by discussing the potential risk factors associated with obesity in preschool children in the KSA and moves on to compare the findings with other

published studies in the field. It provides insight into the feasibility of conducting a healthy lifestyle intervention to improve the health of preschool children and their families in the KSA, and the factors that may influence an adherence to the programme. The other outcomes of the Healthy Living intervention (e.g. improvement in children's dietary intake) are also discussed in this chapter. Finally, the strengths and limitations of this research are presented with recommendations for future work.

Figure 10-1 Summary of findings of studies conducted as part of this PhD project



Prevalence and risk factors of preschool obesity in the KSA

In this PhD project, 150 children participated in a study that aimed to describe the determinants of childhood overweight and obesity in the KSA (Chapter 6). These children were living in the city of Makkah (in the western province of the KSA). Saudi children with overweight/obesity made up 20% (30/150) of the total sample size, a finding consistent with previous data on obesity prevalence (see systematic review reported in Chapter 2). The review focused on Saudi preschool children. It was found that, during the last 5 years, the prevalence of overweight/obesity in Saudi preschool children ranged between 19.6-35.2% across the 13 provinces in the KSA.

Many risk factors were identified through the current PhD project. These included: inappropriate feeding practices (e.g. short duration of exclusive breastfeeding and early introduction of complementary feeding), maternal obesity, sedentary behaviours such as watching television, parental feeding styles and child eating behaviours (Chapter 6). Further risk factors of childhood obesity in the KSA were identified through the qualitative research (Chapter 7). These additional factors included the role of informal care (e.g. by grandparents or domestic helpers), the kindergarten environment (e.g. the presence of a shop selling less healthy snacks) and the hot climate in Makkah, which discourages outdoor physical activity. The overall findings of this PhD project are discussed below and compared to previous research.

Birth Weight

The present project did not find an association between birth weight and the risk of developing overweight/obesity during the preschool years. This finding is consistent with a previous study of 554 Iranian preschool children (aged 4-6 years) ⁽⁷⁵³⁾. However, only the abstract of that study was written in English, while the rest of information was introduced using the Persian language; that hindered performing critical appraisal. Nonetheless, not finding an association between high birth weight and the risk of developing childhood obesity is contrary to a large body of evidence that supports such an association ^(135; 153-156). The absence of an association in the present study could be attributed to

missing data, as many mothers did not remember their child's exact birth weight. Also, the small sample size (n=150) may have hindered detecting such an association. Other developmental factors such as infant feeding practices were associated with obesity risk, as discussed below.

Developmental factors

The WHO recommends that mothers breastfeed their infants exclusively up to the age of 6 months, and introduce complementary feeding at the end of the 6th month ⁽⁷⁶⁹⁾. However, according to the present project, infant feeding practices were far from meeting such recommendations. For instance, 88% of Saudi mothers were successful in initiating breastfeeding on the first day of delivery, but only 6% of them continued to exclusively breastfeed their infants for 6 months. Early complementary feeding (before the 6th month) was reported in almost a quarter of the current sample size. Such practices were associated with a higher risk of overweight/obesity according to the present PhD project. These findings agree with those of many national and international studies ^(157,178,185,214,768,773-775).

There might be several explanations for non-compliance with the guidelines for infant feeding. In the KSA, one possible explanation is the mothers' lack of awareness. Another potential reason is the holding of misperceptions. For instance, a prevalent belief in the KSA is that breast milk is inadequate and there is a need to provide formula and introduce complementary foods earlier than 6 months ⁽⁷⁸⁴⁾. Another example of an unhelpful belief is that mixed feeding allows mothers more freedom in their social life ⁽⁷⁸³⁾. Therefore, it is suggested that health authorities address any misconceptions about breastfeeding. This could be via age-appropriate (e.g. teen-friendly) education sessions in schools or by public health campaigns.

High maternal employment, but with poor maternal support, might be an additional explanation for the inappropriate infant feeding practices in the KSA. For instance, it was reported that 96% of infants with working mothers in KSA were not exclusively breastfed to 6 months of age, a much higher percentage than the infants of unemployed mothers ⁽⁷⁸⁸⁾. One study conducted in the KSA

reported that children of employed mothers had a 1.7 times higher risk of early formula feeding compared to children of unemployed mothers ⁽⁷⁷⁶⁾. Further investigations might help understand the association between mothers' employment status and infant feeding practices.

Cultural factors

It has been suggested that mothers' full-time employment might increase the demand for informal childcare ⁽⁸⁶¹⁾. This may include hiring domestic helpers or asking grandparents to help look after children. As far as the findings of the present study are concerned, the risk of childhood overweight/obesity was higher in children who received informal care compared to parental care. This finding ties in well with the findings of many previous studies ^(399-400, 859-862).

The association between the risk of developing childhood overweight/obesity and receiving informal care provided either by relatives such as grandparents or domestic helpers might be explained by several factors. It has been proposed that unhelpful beliefs held by some childcare providers may explain this association. An example of unhelpful beliefs includes the "bigger is better" concept. This belief might be held by grandparents who lived in a period when food resources were much scarcer, and it may explain why they tend to overfeed their grandchildren ⁽³⁹⁸⁾. Likewise, the belief that being overweight is a marker of wealth and good health may be held by domestic helpers who have experienced periods of deprivation ⁽⁸⁷⁴⁾. A study by Sobko et al. (2017) suggested that long-term child care provided by domestic helpers may mean that these domestic helpers are seen by the children as natural role models. It is therefore quite possible that they play a role in terms of influencing food acceptance patterns in young children ⁽⁸⁷⁵⁾. Therefore, it might be helpful to provide caregivers and domestic helpers with adequate training regarding child feeding practices.

An example of unhelpful beliefs held by carers was found in the qualitative research conducted as part of this PhD project. Early introduction of complementary feeding (during the second month) was perceived as good for a child's health. In line with this, a qualitative study conducted by Lidgate and

Li (2018) reported that grandparents often had their own set of unhelpful beliefs and opinions that were outdated and did not comply with the current recommendations on infant milk feeding and the introduction of complementary foods ⁽⁸⁶⁷⁾.

A further possible explanation of the link between informal care and the risk of developing childhood overweight/obesity includes the belief that it is the right of grandparents to express their love to their children through indulgent feeding practices, as reported in our qualitative research. This agrees with the findings of another study, which reported that some grandparents claimed they had a right to spoil their grandchildren with treats such as sweets and chocolate because the parents' role involves the preparation and provision of primary food ⁽⁸⁶⁹⁾. Our findings are consistent with another qualitative study that found grandparents considered time spent with their grandchildren to be a time for treating them. Less healthy foods, such as ice-cream and sweets, were used as a treat ⁽⁸⁶⁶⁾.

It might be challenging to change the beliefs held by grandparents. The qualitative research of the present thesis highlights the fact that some grandparents would not agree to follow parents' wishes concerning child feeding practices. For instance, one participant reported that her father-in-law was unhappy when she asked him not to allow her children to buy large quantities of sweets from the supermarket. Another mother reported that she tried to explain to her mother-in-law that it would not be appropriate to feed her 2-month-old daughter complementary food. However, the grandmother was not convinced. This is in line with other reports, for example, from Chinese parents who found it difficult to reject the grandparents' beliefs and attitudes toward children's feeding practices ⁽³⁹⁶⁾.

It is possible that the level of respect shown by parents to their own parents (i.e. grandparents) who participate in feeding children differs between cultures. For example, English grandmothers appear to be more respectful of the mother's food choices for her child than Dutch grandmothers, according to a qualitative study conducted by Lidgate and Li (2018) ⁽⁸⁶⁷⁾. Further in-depth research into the impact of informal care on childhood obesity in the KSA would

help clarify such associations and inform possible appropriate solutions. This may include raising awareness in grandparents or designing courses about child feeding practices for domestic helpers. For instance, Bell, Perry and Prichard (2018) proposed an innovative strategy for childhood obesity prevention, which focuses on the role of grandparents in the development of lifestyle interventions in preschool children ⁽⁸⁷⁸⁾. Another potential intervention is to provide carers and grandparents with healthy snack suggestions, as well as suggestions on how to increase the level of physical activity in children ⁽⁸⁶⁷⁾.

Environmental factors

According to the current PhD project, a higher risk of developing preschool overweight/obesity is suggested to be associated with the obesogenic environment of the private kindergarten, such as that which participated in the present study. Additionally, longer durations of screen time and the role of the media were identified as risk factors of developing childhood overweight/obesity in the present project. This is discussed below.

Kindergarten influence

The present study suggested that the kindergarten may influence children's dietary intake through the presence of a shop selling less healthy snacks (e.g. chocolate and candies). Frequent consumption of such energy-dense items may increase the risk of developing childhood obesity. This is supported by the findings of a study conducted in Jeddah, a city that is geographically close to Makkah. That study recruited 820 preschool children across 8 kindergartens. It found that the risk of obesity doubled in children who attended private kindergartens compared to public ones ⁽⁴¹⁶⁾. Consistent findings were also reported in a study conducted in Ghana that included 543 school children from 14 primary schools. That study found that the presence of a shop that sells sweets or processed foods increased the risk of childhood obesity by 5-fold ⁽⁴⁴¹⁾.

Sedentary lifestyle and media influence

In addition to the factors mentioned above, a sedentary lifestyle, including high exposure to screen time, was identified as a determinant of childhood overweight/obesity according to our risk factors study which was conducted as part of the current PhD. This is in agreement with the findings of a systematic review that included 13 reviews. This review found a dose-response relationship between the duration of screen time and the risk of obesity with moderately strong evidence ⁽³¹⁶⁾.

Media influence was also found to be an influencer of child eating preferences in the present project. The qualitative research study found that using cartoon characters (e.g. Paw Patrol) or providing toys (e.g. McDonald's Happy Meal) was associated with a higher intake of less healthy food (i.e. high in sugar and/or saturated fats). This is consistent with the previous literature, which indicated that using cartoon characters or providing toys with meals are considered successful strategies to increase sales ⁽³²⁷⁻³²⁹⁾. However, using such strategies is more prevalent for the marketing of less healthy products. Hence, it is the policymakers' role to impose legislations that could help protect child health.

The current study found that the presence of outdoor play area (vs none) was associated with lower BMI z-score. However, it did not find an association between time spent in physical activity and child BMI z-score. The protective effect of physical activity and the risk of obesity is well documented in the literature ^(287; 297-299). The absence of such an association in the present project might be attributed to a methodological limitation. That is, time spent in physical activity was subjectively measured (i.e. reported by mothers), which might not be accurate. This is in line with the findings of a systematic review, which found that studies that used questionnaires were not likely to detect any association. Conversely, studies that objectively measured physical activity via pedometers found a negative association ⁽⁸⁵³⁾. Thus, it is possible that detecting associations between physical activity and overweight/obesity in preschool children depends on the tools used to examine this association. In general, it is important to note that diet has a greater influence on weight gain

compared to the role of physical activity as highlighted by Davies (2019), according to the last UK CMO ⁽⁹⁵⁷⁾. Hence, further investigations of the impact of physical activity in reducing obesity rate, particularly in preschool children, are needed.

As described above, addressing several risk factors such as media influence and the obesogenic environment in private kindergartens would require action from the policymakers and the Saudi authorities. Establishing the appropriate legislation to regulate the content of media, as well as the availability of less healthy food in kindergartens may help address this problem. Educational campaigns might be helpful to address other factors including the influence of grandparents or domestic helpers in shaping dietary habits. Additionally, establishing a baby friendly hospital initiative could help address prevalent inappropriate beliefs with regard to infant feeding practices.

This PhD project focused on improving modifiable risk factors of obesity in preschool children, including diet, physical activity and parental feeding practices. This was achieved through the implementation of a multi-component intervention that complies with the UK NICE guidelines for childhood obesity preventative interventions. The adaptation of a successful existing intervention provides a means to reduce the cost and time burden of research. The Trim Tots intervention was identified as one of the few multi-component interventions that was successful in reducing BMI z-score in preschool children. The intervention integrated the NICE guidelines for obesity prevention and its effectiveness was tested through 2 RCTs. Therefore, the current PhD project applied a cultural adaptation to the Trim Tots intervention to make it suitable for the Saudi community, as described in Chapter 8. The adapted intervention was named the Healthy Living Study. A pilot RCT was carried out to test the feasibility of conducting such a healthy lifestyle intervention for Saudi preschool children and their families in the KSA. The outcomes of the feasibility trial are discussed below.

The feasibility of conducting the Healthy Living intervention in the KSA

The implementation of a healthy lifestyle intervention in the KSA was feasible and acceptable by the Saudi Arabian public. For instance, on average, participants attended 80% of the intervention sessions. Obtaining anthropometric measurements and completing questionnaires was also possible and adequate space and equipment was provided by the kindergarten. Mothers provided positive feedback with regards to the intervention. For instance, many mothers reported that their children started to show positive attitudes toward healthy eating. Others expressed their wishes to run such a programme for a longer duration.

The culturally adapted intervention was accepted. This is in line with previous literature, which reported that consideration of cultural sensitivity was associated with greater acceptance of the intervention by the local population⁽⁵³⁹⁾. The adaptation process went through two main stages. The first stage involved modification to the format and mode of delivery. This was achieved in accordance with the feedback from the initial exercise of the patient and a public involvement and the qualitative research. The results showed that time constraint was a striking barrier to participation in a healthy lifestyle intervention for Saudi mothers, who found it difficult to attend the intervention sessions. Thus, the main modification was to change the mode of delivery of the parental component. Parental sessions were transferred from face-to-face into a digitalized format delivered via WhatsApp.

It was postulated that the modification process described above would help to increase adherence to the intervention. This was because the positive influence of incorporating technology in delivering health interventions is widely documented in the literature⁽⁶⁴⁷⁻⁶⁴⁸⁾. The proliferation of handheld devices with easy online accessibility could facilitate the participation in digital interventions. Mothers who participated in the Healthy Living intervention received educational materials on WhatsApp and had the opportunity to talk openly with other parents and with me (the dietitian) as well. These mothers were encouraged to ask questions and interact, and I made sure they received full and prompt replies. A previous systematic review suggested that weight

management programmes, in which dietitians are actively engaged, are often more effective than those established without dietitians ⁽⁹⁵⁸⁾. Turk et al. (2013) found that immediate feedback to adults who participated in weight management interventions increased adherence to interventions and was associated with greater weight loss ⁽⁹⁰⁵⁾.

Providing digital interventions to parents is likely to be more convenient and cost-effective compared to the implementation of face-to-face sessions. However, further research is needed to investigate their costs and overall effectiveness. It might be worth considering a restructure of the timing and duration of online interactive sessions provided by health workers. This is important for the time management of staff, who provide online interventions that must fit in with their work at clinics and hospitals.

The second stage of the adaptation involved a modification to the content of the intervention. This was important to deliver an appropriate intervention that could meet the needs of the Saudi population. The feedback from both the risk factors study (Chapter 6) and the qualitative research (Chapter 7) helped inform the adaptation process. For instance, the lack of healthy recipes was considered a barrier to the adoption of healthy eating habits according to the qualitative research. Thus, mothers were provided with tips on healthy cooking. In addition, they were provided with an air fryer to help encourage the replacement of deep frying and preparation of healthier meals. Although the intervention did not result in a significant change in child BMI z-score, it did improve other obesogenic related aspects, as discussed in the coming sections.

The impact of the Healthy Living intervention in reducing obesity risk

The influence of the Healthy Living study was evaluated by measuring child BMI z-score immediately after the intervention (3 months from baseline). There was a reduction in child BMI z-score between the randomised groups after the intervention; however, the difference was not significant. Nonetheless, the intervention offered significant improvements in other obesity-related outcomes. This included higher consumption of fruits and vegetables in

children in the intervention group. Moreover, instrumental feeding scores were reduced significantly in mothers who participated in the intervention compared to the control group.

The findings of the current study are consistent with those of an umbrella review carried out by Matwiejczyk et al. (2018). That review investigated the effectiveness of obesity prevention interventions in early childcare settings by studying 12 systematic reviews. It was reported that although no significant changes in anthropometric measurements were found in these reviews, 8 reported improvements in children's eating habits (e.g. higher consumption of fruits and vegetables or a lower fat intake) ⁽⁵¹⁹⁾. More recent studies have reported similar findings, including a lifestyle intervention known as Time2bHealthy ⁽⁶⁶⁴⁾ and the HENRY programme (Health Exercise Nutrition for the Really Young) ⁽⁹²³⁾.

The Healthy Living intervention was a pilot trial designed to inform a future larger trial including with sample size calculations. A potential explanation for the absence of a significant change in child BMI z-score by lifestyle interventions was provided by Mehdizadeh et al. (2020). They suggested that changes in BMI may not be appropriate for evaluating the efficacy of interventions. This is because focusing on improving obesity-related factors – including eating habits, physical activity, parental feeding practices and environmental issues – is more likely to affect weight status over a sufficient period of time ⁽⁶³⁷⁾. It was documented in the literature that longer term interventions were associated with greater effect size ⁽⁴⁸²⁾. For example, one study required up to one year to result in a significant reduction of child BMI z-score ⁽⁵⁷³⁾. Other studies required a longer duration (up to 2 years) ⁽⁹²⁶⁾ and (up to 3 years) ⁽⁹²⁷⁾ to result in significant improvement of anthropometric measurements.

The non-significant influence of the Healthy Living intervention on children's BMI z-score might be due to insufficient physical activity – especially in a city like Makkah, where hot weather is a barrier to regular daily outside movement. Our study only provided one 30-minute session of physical activity per week. Although the intervention provided mothers with suggestions to encourage

their children to be more physically active, no significant difference was detected in terms of time spent on physical activity in our sample. Therefore, it might be helpful to increase the physical activity component in future studies targeting Saudi children, although it is unclear whether this will lead to changes in physical activity habits in the KSA population.

Using a multi-level intervention, which may target several levels including the community settings, school environment and home, could also produce a favourable effect for intervention in terms of reducing the rates of obesity in preschool children ⁽⁵¹⁹⁾. In addition to considering several levels, targeting several components, such as diet, physical activity and behaviour change, could be helpful in addressing obesity. A recent systematic review of 30 studies involving 23,185 preschool children from 9 countries supported the effectiveness of multi-component multi-level interventions that addressed eating habits, physical activity and environmental factors at distinct levels ⁽⁵³⁹⁾.

Interestingly, although there was no significant difference in child BMI z-score by the end of the intervention (3 months from baseline), BMI did not increase at 6 months following intervention completion (9 months from baseline) like in other Saudi populations during lockdown ⁽⁹⁵⁹⁻⁹⁶⁰⁾ (the study coincided with the national lockdown in the KSA).

Maintaining a lower BMI z-score in children of the intervention group during the COVID-19 lockdown is promising because other studies reported that the lockdown had adversely impacted the dietary habits and lifestyle factors for both children and adults ⁽⁹⁶¹⁾. Possible adverse effects of lockdown include a higher intake of energy-dense foods in children and being less physically active, which could lead to excess weight gain ⁽⁹⁴⁹⁾. The whole-school National Child Measurement Programme (NCMP) in the UK found that the lockdown adversely affected dietary habits and physical activity of the population ⁽⁹⁶²⁾. It was reported that during the lockdown in the UK, the proportion of overweight and obesity in preschool children increased by 9% ⁽⁹⁶³⁾. In Greece, 35% of children gained excess weight during the lockdown ⁽⁹⁵⁰⁾. It is possible that the Healthy Living intervention provided a way of preventing excess weight gain during a period in which sedentary behaviour became the norm. This may have

been achieved through improved dietary habits of children and the raised nutrition knowledge of parents, as discussed below.

Regardless of the absence of a significant reduction in child BMI z-score, there was a significant improvement in children's dietary habits at the end of the intervention. This included a higher consumption of fruits and vegetables. This improvement could possibly be attributed to the engagement of children in snack preparation during sessions held in the kindergarten. This is supported by the previous literature; for instance, it was reported that engaging children in healthy meal preparation correlated positively with child preferences for vegetables ⁽⁹³⁵⁾ and hence a higher consumption of vegetables during preschool years ⁽⁹³⁶⁾.

A further explanation for the increased intake of healthy foods as a result of the intervention could be that mothers were provided with a variety of techniques to improve their children's dietary habits. These included modelling, repeated taste exposure, reward, visual presentation and increasing the availability and accessibility of healthy foods in the home environment. The effectiveness of these techniques is supported by a systematic review of 30 articles and 44 interventions that aimed to identify successful strategies to increase vegetable intake in preschool children (2-5 years) ⁽⁶²⁸⁾.

As well as the positive effect of the intervention on children's dietary habits, the process also resulted in a significant improvement in mother's feeding styles. The mothers of children in the intervention group had lower rates of instrumental feeding behaviour than the mothers of children in the control group. This is an important finding, as the link between instrumental feeding and overweight/obesity in children has been documented in previous research ^(258,260,262,267). The effectiveness of the Healthy Living intervention in reducing instrumental feeding scores could possibly be attributed to increasing mothers' awareness with this regard. Similar findings were reported by a study that provided healthy-behaviour counselling to the parents of preschool children with rapidly increasing BMI ⁽⁹⁴⁷⁾.

The Healthy Living intervention did not only improve children's dietary habits, but it was also helpful for mothers. It resulted in a significant reduction in BMI in mothers (by 0.5 kg/m²) at the end of the intervention and 6 months following intervention completion. Our findings are in line with those reported by the Cochrane review conducted by Colquitt et al. (2016). That review included 7 RCTs with a total of 923 participants, and found significant reduction in the BMI of parents (by 2.0 kg/m²) who participated in the multicomponent interventions that addressed obesity in preschool children ⁽⁵³⁵⁾.

It is likely that the improvement in mothers' BMI could be attributed to providing them with behaviour change techniques. This is supported by the findings of a review of 6 systematic Cochrane reviews that aimed to provide evidence of successful interventions in treating obesity. It was reported that behavioural change was the cornerstone of effective interventions, as indicated by all 6 reviews ⁽⁶³⁰⁾. The behaviour change techniques taught to mothers in the Healthy Living intervention included setting SMART goals (Specific, Measurable, Achievable, Relevant and Time-limited). It is possible that setting SMART goals increased mothers' motivation toward adopting healthier dietary and lifestyle habits ⁽⁹⁵⁴⁾. In addition to learning how to set SMART goals, mothers were taught how to review the progress of achieving the goals they had set. This included identifying barriers and weighing the pros and cons of goal achievement. Previous research suggested that when participants are more aware that the advantages of the new behaviour outweighs the disadvantages, they would develop a positive attitude towards the targeted behaviour ⁽⁶⁹²⁾.

Another aspect of the intervention that may have facilitated weight reduction in mothers is the provision of healthy cooking tips and an air fryer to replace traditional deep-frying and reduce added fat in meals. Previous research suggested that healthy cooking techniques have been associated with a lower consumption of fat ⁽⁹⁵⁵⁾, ultra-processed food ⁽⁹⁵⁶⁾ and encouraged healthy eating, which is associated with a reduced risk of developing overweight/obesity ⁽⁹¹⁸⁾.

It is also important to consider the fact that the intervention was guided by a theoretical framework as recommended by the UK Medical Research Council ⁽⁶⁷⁶⁾. It is suggested that underpinning an intervention to a theory might enable the identification of specific mechanisms that are effective in producing a positive health outcome ⁽⁶⁷⁵⁾. The parental component of the Healthy Living intervention was guided by the Transtheoretical Model of Behaviour Change (TTM). The TTM focuses mainly on using the stages of behaviour change to enhance the mother's motivation towards improving their lifestyle and dietary habits ⁽⁶⁹⁰⁾. As mentioned previously, these mothers were encouraged to become role models for their children to promote healthy eating habits. Additionally, these mothers were provided with distinct behaviour change techniques to enable them and their children to adopt healthier lifestyle and dietary habits.

The child component of the intervention was underpinned by the Social Cognitive Theory (SCT), which relies on the basis that young children learn by observation and imitation ⁽⁶⁸⁰⁾. According to the SCT, child eating behaviour and nutritional knowledge can be acquired through socialisation with others who could become role models (e.g. parents or caregivers). Hence, it is expected that underpinning each component of the intervention with an appropriate framework may increase the potentiality of improving obesity-related factors ⁽⁶⁷⁷⁾. Overall, the positive effect seen as a result of the Healthy Living intervention, in terms of improving parental feeding style and child dietary intake, may be attributed to the fact that such a programme was guided by a suitable theoretical framework.

10.1 Research strength

To the best of my knowledge, this is the first study that has implemented a culturally-tailored obesity preventative intervention targeting preschool children and their families in the KSA. The main strength of this study is that the intervention was adapted and carried out to suit the characteristics of the Saudi population. The content of the intervention was tailored to address risk factors of developing obesity in Saudi preschool children, as well as barriers to adopting healthy lifestyle habits that are specific to the region. These were

important to increase the acceptability of the intervention, as well as to provide beneficial information to the participants. Additionally, barriers and enablers of participating in a healthy lifestyle intervention were taken into consideration. This was important to increase participant adherence to the intervention.

Another strength of this PhD project was the use of a mixed-methods approach, which allowed a better understanding of the risk factors of obesity in Saudi preschool children. The qualitative work allowed participants to have a voice in the way the intervention was adapted and carried out to suit their preferences. The qualitative work also shed light on the cultural factors that may contribute to obesity in the KSA, such as the role of grandparents and domestic helpers. This is one area that needs further investigation. The objective assessment of children's anthropometric measurements (at the end of the intervention) by trained researchers is likely to reduce the potential for bias and errors resulting from parent-reported measurements. Meanwhile, interview questionnaires allowed us to gather a richer level of data and hopefully reduce the possibility of missing information.

10.2 Limitations

The current thesis has several weaknesses. Limitations in the study of risk factors (Chapter 6) included the small sample size ($n=150$) and confining the study to one location (a private school), in which the enrolled participants were likely to come from a higher socio-economic class. This limits the generalisability of the findings. Additionally, the observational nature of the cross-sectional study obscured the detection of causality. Subjective measurements of physical activity that were reported by parents may also have adversely impacted the validity of the measurements, so it is recommended for future research that such factors be tested using more valid tools such as accelerometers or pedometers.

Although the current study investigated key modifiable and non-modifiable risk factors, such as socio-demographic, developmental, dietary and behavioural factors, it is possible that unknown confounding factors may have not been measured. For example, the school in our study had a cafeteria that sold

convenience foods to the children, while this practice is not allowed in other kindergartens. A confounding factors like this may influence the association between the independent variables with the risk of developing overweight/obesity in preschool children. Further investigation of other cultural confounding factors is therefore warranted.

The qualitative study (Chapter 7) provided in-depth information concerning barriers to healthy lifestyles and the barriers to participating in interventions from the point of view of Saudi parents. However, the nature of qualitative research relied on individuals' own perspectives and personal experiences. Thus, the replication of qualitative research findings is difficult, especially because perspectives can change over time. The reliability of data may only be valid at the time it was gathered.

A further limitation concerning the process of adapting the Trim Tots intervention (Chapter 8), was the focus on the individual level, rather than the environmental level. For example, the intervention did not target the kindergarten environment, including improvements in food service. It was difficult to change the regulations of selling less healthy snacks or increase healthy food availability in the cafeteria. It is well documented that multi-component multi-level interventions produce a more pronounced influence on the reduction of overweight/obesity in children.

Regarding the intervention implementation (Chapter 9), the small sample size ($n=30$) and short duration prevented us from drawing firm conclusions about its efficacy in reducing overweight/obesity rates in the KSA. The study was also only conducted in one kindergarten, so there was a possibility that cross-contamination bias might occur. Future studies that enable testing the intervention in a wider population using a cluster randomised controlled trial design are recommended. Although the parents' feedback regarding the intervention was positive, their responses might be biased by social desirability.

10.3 Implications and recommendations for future work

The preschool years are a critical period during which dietary and lifestyle habits start to develop. Once established, they can be followed through to adulthood and may be very difficult to change. Unhealthy dietary habits accompanied by sedentary lifestyles can result in many adverse health issues, including the development of obesity. The implementation of lifestyle interventions targeting preschool children and their families is an important step towards addressing the epidemic of obesity in Saudi preschool children.

The findings of this PhD project are helpful in informing policymakers who may impose legislation that could promote child health and have several implications for future research addressing childhood obesity in the KSA. Firstly, the findings can be put towards the enhancement of our understanding of risk factors associated with overweight/obesity in the country. It is clear that infant feeding practices are a long way from meeting the WHO and UNICEF guidelines, so it is important to raise parents' awareness regarding these aspects, via community campaigns for example. The active implementation of the Baby-Friendly Hospital Initiative in more hospitals in the KSA is also of considerable importance. Encouragement of infant exclusive breastfeeding could be helpful to reduce childhood obesity rates. It is, therefore, the responsibility of policymakers to support employed mothers, by providing maternity leave for at least 6 months after delivery, and it is also important to offer flexible working hours to breastfeeding mothers after returning to work.

Secondly, the current PhD project casts light on the role and impact of informal childcare (by relatives or domestic helpers) on the risk of developing childhood overweight/obesity. Further investigations into the potential effects of such adverse behaviours are required. Interesting questions for future research that have come from this investigation include:

- 1) What are the beliefs and perceptions of Saudi grandparents and domestic helpers who participate in child feeding?
- 2) How does informal care contribute to shaping the dietary habits of Saudi preschool children?

- 3) Is it feasible to conduct interventions to target informal carers to improve their nutritional knowledge and child feeding behaviour in the KSA?

Thirdly, the environment of the kindergarten that participated in this study could be considered obesogenic. It was reported that the establishment facilitated the provision of convenience foods to children and provided energy-dense snacks. Instrumental feeding practices by at least one member of staff were also reported. These findings are useful for decision makers, who set policies and regulations that aim to provide a healthy environment for children in kindergartens. Improving the kindergarten environment could play a vital role in addressing high rates of obesity in Saudi preschool children. This could include training staff and raising their nutritional knowledge and awareness as well as managing the availability of less healthy food items at the cafeteria.

Fourthly, the implementation of lifestyle interventions such as the Healthy Living study is promising, as it has the potential to improve children's dietary habits and parents' feeding styles. However, the intervention did not result in a longer time spent on physical activity. It may therefore be worth increasing the physical activity components in future research. Meanwhile, to address potential cross-contamination bias, we recommend testing the intervention using a randomised cluster design.

Finally, incorporating technological advances into the delivery of the parental component appeared to be useful and provided more flexibility to all participants involved. This is likely to increase adherence to the intervention. Future research directions are therefore recommended to take advantage of online tools in the delivery of interventions as it could be more cost-effective.

10.4 Chapter summary

The KSA ranks among the world's top 10 countries for obesity prevalence. However, data informing the prevalence and risk factors of obesity in Saudi preschool children are limited. Thus, the first step in this PhD project was to conduct a systematic review, which found that the prevalence of overweight and obesity in Saudi preschool children is high and there is a deficiency in studies investigating determinants of preschool obesity in the region. Hence, it was concluded that more studies are required to identify risk factors of obesity in preschool children and develop lifestyle intervention addressing such epidemic. Therefore, this PhD project covered these gaps by conducting 4 studies.

Study 1 was the risk factors research. It provided an understanding of the determinants that are associated with overweight/obesity in Saudi preschool children. Study 2 was qualitative research; it provided in-depth data on barriers to adopting a healthy lifestyle, as well as discovered enablers for the Saudi population to participate in a lifestyle intervention conducted in the KSA. Study 3 used the feedback of both previous studies to apply a cultural adaptation of the Trim Tots intervention, a previously designed programme that complies with the guidelines of obesity prevention during early age with evidence of success at reducing obesity risk in preschool children living in the UK. The adapted intervention was named the Healthy Living Study. Study 4 was a pilot RCT that tested the feasibility of conducting a culturally tailored healthy lifestyle intervention (i.e. the Healthy Living study) in the KSA.

The Healthy Living study was feasible and acceptable to the Saudi population. Although the intervention did not result in reducing child BMI z-score significantly, it was effective in improving children's dietary habits and parental feeding style. These factors, in the long term, may help reduce the risk of obesity in Saudi preschool children and their families. Future studies to evaluate feasibility and efficacy of the Healthy Living intervention, in a wider preschool Saudi population through a cluster randomised trial, are warranted.

10.5 Conclusion

This PhD project represents a step towards providing a better understanding of the risk factors of preschool obesity in the KSA. This was achieved via conducting cross-sectional and qualitative studies. However, the sample size in each study was not large. Hence, further investigations of such determinants are needed. This PhD project also made the first attempt at conducting a culturally-adapted intervention addressing obesity specifically for Saudi Arabian preschool children. The Healthy Living intervention, to the best of my knowledge, is the first multi-component childhood obesity prevention programme implemented in the KSA. Although it did not reduce BMI z-score significantly, it improved other obesity-related factors. However, the parents recruited in this pilot RCT were educated and hence, they might be already motivated to interact well with the interventionist. Therefore, further evaluation of this intervention in terms of design, participants' involvement and duration is recommended for future research.



‘Children are our greatest treasure, they are our future’
Nelson Mandela

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Appendix A: Search strategy of the systematic review of obesity prevalence and risk factors in Saudi preschool children (0-6 years)

Search strategy for EMBASE

- 1 obesity/ or childhood obesity/ 461395
- 2 (Overweight or Obes*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] 625397
- 3 1 or 2 625397
- 4 child/ or preschool child/ or toddler/ 1886228
- 5 (child* or preschool* or pre-school* or toddler*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] 2688257
- 6 4 or 5 2688257
- 7 Saudi Arabia/ 24316
- 8 (ksa or saudi arabia*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] 30503
- 9 7 or 8 30503
- 10 3 and 6 and 9 337
- 11 risk/ or risk factor/ 1553870
- 12 birth weight/ or body weight/ or high birth weight/ or low birth weight/ 407009
- 13 "growth rate and growth regulation"/ or growth acceleration/ 2561
- 14 growth/ or exp body growth/ 58685
- 15 breast feeding/ or infant feeding/ 60266
- 16 feeding behavior/ or nutrition/ or appetite/ or eating habit/ or food preference/ or portion size/ 221824
- 17 physical activity/ 174430
- 18 sedentary lifestyle/ 16105
- 19 screen time/ 1357
- 20 diet/ 216756
- 21 eating/ or food intake/ 163969
- 22 fast food/ 8745
- 23 (Determinant* or risk factor* or birthweight or birth weight or growth or breastfeeding or breast feeding or infant feeding or child eating behavior* or feeding style or physical activit* or sedentary behavior* or screen time or diet or nutrition or eat* or fast-food).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] 5230589
- 24 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 5842909
- 25 10 and 24 254

Search strategy for MEDLINE

- 1 obesity/ or pediatric obesity/ 201958
- 2 (Overweight or Obes*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] 402557
- 3 1 or 2 402557
- 4 child/ or child, preschool/ 1994448
- 5 (child* or preschool* or pre-school* or toddler*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] 2557331
- 6 4 or 5 2557331
- 7 Saudi Arabia/ 14683
- 8 (ksa or saudi arabia*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] 24841
- 9 7 or 8 24841
- 10 risk/ or risk factors/ 1000544
- 11 body weight/ or birth weight/ or body weight changes/ or weight gain/ 258218
- 12 "growth and development"/ or growth/ 28250
- 13 feeding behavior/ or breast feeding/ 125325
- 14 nutritional physiological phenomena/ or appetite regulation/ or child nutritional physiological phenomena/ or diet/ or portion size/ or serving size/ or eating/ or food preferences/ 259839
- 15 Appetite/ 8149
- 16 Exercise/ 121435
- 17 Sedentary Behavior/ 11247
- 18 screen time/ 636
- 19 Fast Foods/ 2435
- 20 (Determinant* or risk factor* or birthweight or birth weight or growth or breastfeeding or breast feeding or infant feeding or child eating behavior* or feeding style or physical activit* or sedentary behavior* or screen time or diet or nutrition or eat* or fast-food).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] 4240471
- 21 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 4542622
- 22 3 and 6 and 9 and 21 172

Appendix B: Modified Downs and Black Checklist

SECTIONS	SCORE
REPORTING	
Question 1: Is the hypothesis/aim/objective of the study clearly described?	
Question 2: Are the main outcomes to be measured clearly described in the introduction or methods section?	
Question 3: Are the characteristics of the participants included in the study clearly described?	
Question 6: Are the main findings of the study clearly described?	
Question 7: Does the study provide estimates of the random variability in the data for the main outcomes?	
EXTERNAL VALIDITY	
Question 11: Were the participants asked to participate in the study representative of the entire population from which they were recruited?	
Question 12: Were those participants who were prepared to participate representative of the entire population from which they were recruited?	
INTERNAL VALIDITY – BIAS	
Question 18: Were the statistical tests used to assess the main outcomes appropriate?	
Question 20: Were the main outcome measures used accurate (valid & reliable)?	
Total	

Appendix C: Patient Information Sheet for the risk factors study



منشور المشاركة للآباء والأمهات
رقم معرف موافقة لجنة الأخلاقيات البحثية في جامعة لندن
PE017



برنامج دكتوراه بعنوان " : حياة صحية " .. الجزء 1
لدراسة محددات زيادة الوزن في المملكة العربية السعودية وتحسن نمط حياة
القسم: معهد صحة الطفل بجامعة لندن.

اسم وتفاصيل الاتصال الخاصة بالباحث : مي غياشي

رقم الهاتف : [REDACTED]

البريد الإلكتروني

[REDACTED]

اسم وتفاصيل الاتصال بالباحث الرئيسي : الدكتورة جولي لانيجان

[REDACTED]

البريد الإلكتروني

[REDACTED]

دعوة

نود أن ندعوك أنت وطفلك للمشاركة في برنامج الحياة الصحية. توفر لك هذه النشرة معلومات حول البرنامج و الهدف منه، و البيانات المطلوبة للتسجيل. يرجى قراءة المعلومات أدناه ، ولا تترددى ابدا في الاستفسار عن أي أمور قد تكون غير واضحة لك ، كما يسرنا التواصل معك إذا كنت ترغبين في تزويدك بمعلومات إضافية .إنه قرارك الخاص فيما إذا كنت ترغبين في أن تشاركي أنت وطفلك في هذا البرنامج

ما هو الغرض من برنامج الحياة الصحية؟

الهدف منه هو معرفة نمط الحياة للطفل و الاسره و معرفة أيضا كيف يمكن أن تؤثر العوامل الخارجية على العادات الغذائية بن الأطفال في سن ما قبل المدرسة و الذين تتراوح أعمارهم بن 3-6 سنوات في مدينة مكة المكرمة ، المملكة العربية السعودية. تم تصميم برنامج "الحياة الصحية" لمساعدة الأمهات و مقدمي الرعاية على اتخاذ خيارات صحية ونمط حياة مناسب لأطفالهم قبل سن المدرسة. نأمل أن نكتشف من البرنامج العوامل المرتبطة بتكوين العادات الغذائية المؤدية لزيادة الوزن عند الأطفال و معالجتها منذ بداية نشوؤها

لماذا نقوم بعمل هذا البرنامج ؟

أشارت الدراسات الحالية إلى أن العادات الغذائية تتكون في مرحلة الطفولة المبكرة وأن هذه العادات تؤثر تباعا على خيارات نمط الحياة في المستقبل وقد تزيد من خطر السمنة او الإصابة بالامراض المزمنة كالسكري و القلب لا سمح الله. أجريت دراسات قليلة في المملكة العربية السعودية و لذلك فأنا بحاجة الى مثل هذه البرامج ، و التي بالتالي ستوفر معلومات أساسية للوقاية من السمنة أثناء الطفولة و ما بعدها

لماذا تم اختيار طفلي؟

تتم دعوة الأطفال المعرضين لزيادة الوزن من أجل مشاركة في هذا البرنامج

كيف يتم عمل برنامج الحياة الصحية؟

بعد شرح الدراسة لك في روضة "حديقة الطفل" ، سيطلب منك التوقيع على نموذج موافقة ، مما يسمح لك ولطفلك بالمشاركة في هذه الدراسة و بالطبع سيتم تزويدك بنسخة من نموذج الموافقة . سوف تتطلب دراسة الحياة الصحية قياساً لك أنت وطفلك كما هو موضح ادناه

القياسات

جميع القياسات سهلة وبسيطة و لا تسبب أي ألم على الاطلاق و هي كالآتي:

-قياسات الوزن و الطول و محيط الخصر لك انت و طفلك

-قياس سمك كثافة الجلد للطفل و ذلك من ثلاث مواضع (مقدمة عضلة الذراع) ، (عضلة الذراع الثلاثية) (اسفل البطن). هذه القياسات لا تتطلب ان يكون الطفل مجردا من ثيابه بشكل كامل و انما فقط حيث موضع القياس.

- سيكون هناك عن بعض الأسئلة بخصوص النشاط البدني و التاريخ المرضي للأسرة و ما اذا كان الطفل بحاجة الى اخذ ادوية معينة

-أيضا لدينا أسئلة بخصوص عادات الطفل الغذائية

-و سنطلب منك تعبئة مذكرات بخصوص ما يتناوله الطفل خلا 24 ساعة لمدة 5 أيام

هل يجب علي و على طفلي أن نشارك؟

الأمر متروك لك لتقرري الانضمام إلى برنامج الحياة الصحية. إذا وافقت على المشاركة ، فسنطلب منك التوقيع على نموذج الموافقة. قد ترفض المشاركة في أي جانب من جوانب الدراسة في أي وقت. تستطيعين الانسحاب في أي وقت دون إبداء سبب. لن يؤثر هذا على مستوى الرعاية التي يتلقاها أنت أو طفلك.

ما هي العيوب والمخاطر المحتملة للمشاركة؟

لا توجد عيوب محتملة أو أي مخاطر متوقعة من المشاركة على الإطلاق فالبرنامج امن جدا وبسيط

ما هي الفوائد من المشاركة؟

المعلومات التي نحصل عليها من هذه الدراسة ستساعد في فهمنا لعوامل خطر السمنة لدى الأطفال ولمساعدتنا في تصميم برامج مصممة خصيصا للمساعدة على بناء مجتمع صحي

ماذا لو حدث خطأ ما؟

ليس من المتوقع حدوث أي خطأ فالبرنامج معتمد من قبل لجنة أخلاقيات البحث في كل من المملكة العربية السعودية والمملكة المتحدة ومع ذلك ، إذا كان لديك أي مشكلة ، يرجى التحدث إلى الباحث على [REDACTED] الذي سيبذل قصارى جهده على حل أي امر قد يواجهك

شكاوي

إذا كانت لديك أي شكاوى حول الطريقة التي عوملت بها ، فيرجى الاتصال بالباحثة الرئيسية مي غباشي في المقام الأول على [REDACTED] إذا كنت ترغب في تقديم شكاوى رسمية فاتصل بالدكتور. حسان بخاري من جامعة أم القرى ، كلية العلوم الطبية التطبيقية ، قسم التغذية السريرية على [REDACTED] وبالإضافة إلى ذلك ، يحق لك المطالبة بالتعويض في محكمة قانونية الحقيقة ان أي آثار سلبية خطيرة هي امور ليست محتملة ابداف البرنامج امن جدا. ومع ذلك ، في حالة حدوث أي إصابة ، سوف نتصل بك وسيحصل طفلك على الرعاية الصحية المناسبة. تغطي وزارة الصحة في المملكة العربية السعودية كافة المواطنين.

هل تبقى مشاركتي في دراسة الحياة الصحية سرية؟

نعم بالتأكيد، إذا وافقت على المشاركة في هذه الدراسة ، فإن المعلومات التي تم الحصول عليها أثناء مشاركتك في البرنامج وكذلك السجلات الصحية ذات الصلة ستبقى سرية للغاية في جميع الأوقات. لن يتم التعرف عليك في أي تقارير أو منشورات . سيتم الاحتفاظ بالمعلومات بشكل آمن على الورق وإلكترونيًا بموجب أحكام اللائحة العامة لحماية البيانات لعام 2018 م لن يتم نقل اسمك إلى أي شخص آخر خارج فريق البحث أو الراعي الذي لا يشارك في التجربة. سيتم تخصيص رقم مشاركتك لك ، والذي سيتم استخدامه كرمز لتحديد هويتك ضمن اطار غرض البحث العلمي

ماذا سيحدث إذا لم أكن أرغب في متابعة دراسة الحياة الصحية؟

يمكنك الانسحاب في أي وقت دون أي عواقب ، ودون التأثير على مستوى الرعاية التي يتلقاها

طفلك. لن يتم تضمين بياناتك وسيتم إتلافها بشكل مناسب

ماذا سيحدث لنتائج برنامج الحياة الصحية؟

سيتم نشر نتائج الدراسة في مجلة طبية أو تقديمها في مؤتمر علمي. ستكون البيانات مجهولة ولن يتم تحديد أي من المشاركين في التجربة في أي تقرير أو منشور. إذا كنت ترغب في رؤية النتائج أو المنشور ، فيرجى سؤال الباحث الرئيسي عن ذلك

إشعار خصوصية حماية البيانات

تنويه: ستكون الجهة المسؤولة عن حماية البيانات لهذا المشروع هي جامعة لندن ذلك يشمل معالجة البيانات الشخصية ، و يمكن أيضاً الاتصال بمسؤول حماية البيانات في

UCL على

data-protection@ucl.ac.uk.

ستتم معالجة بياناتك الشخصية للأغراض الموضحة في هذا الإشعار. يمكن العثور على مزيد من المعلومات حول كيفية استخدام UCL للمعلومات المشاركين في إشعار الخصوصية "العام" الخاص بنا من خلال الموقع

: <https://www.ucl.ac.uk/legal-services/privacy/participants-health-and-carerresearch-privacy-notice>

2018 DPA (و GDPR) يتم توفير المعلومات المطلوبة للمشاركين بموجب قانون حماية البيانات الأساس القانوني المستخدم لمعالجة البيانات الشخصية للفئة الخاصة سيكون للأغراض العلمية والتاريخية أو للأغراض الإحصائية و ستتم معالجة بياناتك الشخصية طالما كانت مطلوبة لمشروع البحث بشكل سري جداً. سنعمل على إخفاء الهوية الشخصية للبيانات الشخصية التي تزودنا بهاو عدم الكشف عن اسمها المستعار ، وسنسعى لتقليل معالجة البيانات الشخصية إلى الحد الأدنى حيثما أمكن ذلك. إذا كنت مهتماً بكيفية معالجة بياناتك الشخصية ، أو إذا كنت ترغب في الاتصال بنا بشأن حقوقك ، فيرجى الاتصال بـ UCL في المقام الأول على

data-protection@ucl.ac.uk

من يقوم بتنظيم وتمويل البحث؟

حصل الباحث على أموال من خلال منحة دراسية لجامعة لندن ، من قبل جامعة أم القرى في المملكة العربية السعودية. الراعي الثاني شركة الدار المكية في المملكة العربية السعودية.

من الذي راجع برنامج الحياة الصحية؟

تمت مراجعة هذا البرنامج وإعطاء رأي إيجابي عليه من قبل لجنة أخلاقيات البحث العلمي مزيد من المعلومات وتفاصيل الاتصال إذا كنت بحاجة إلى أي معلومات إضافية أو لديك أي مخاوف أثناء المشاركة في الدراسة ، فيرجى الاتصال بأحد الأشخاص التاليين: باحث رئيسي الاسم مي غباشي الرقم : [REDACTED] مشرف الاسم د.حسان بخاري هاتف.

الرقم : [REDACTED] إذا قررت أنك ترغب في المشاركة ، فالرجاء قراءة وتوقيع نموذج الموافقة. سيتم إعطاؤك نسخة من ورقة المعلومات هذه ونموذج الموافقة على الاحتفاظ بها. يمكنك الحصول على مزيد من الوقت للتفكير.

شكراً لأخذ الوقت الكافي لقراءة هذا المنشور للمشاركة في البرنامج

Appendix D: Consent form for participation in the risk factors study

رقم الدراسة المعتم

17PE01

رمز المشترك الخاص

إقرار الموافقة على المشاركة

عنوان البحث : زيادة الوزن في المملكة العربية السعودية : بين المسببات و وسائل الوقاية

برنامج الحياة الصحية: دراسة مسحية

اسم البحث: مي عادل غباشي

يرجى وضع علامة امام الفقرات التالية:

- 1- اقر بأنني قرأت وفهمت نشرة شرح البحث (المعدة بتاريخ 20-يونيه-2019) الخاصة بالدراسة المذكورة أعلاه. و قد اتيتحت لي الفرصة للتفكير و طرح الأسئلة و الحصول على الإجابات الشافية. ☐
- 2- لقد فهمت ان مشاركتي هي امر اختياري و ليس اجباري ابدا و انه يحق لي الانسحاب متى شئت دون ذكر الأسباب و دون أي عواقب سواء علي شخصا او على طفلي. ☐
- 3- لقد فهمت ان المعلومات التي سأذكرها سيطلع عليها فقط الباحثين المعتمدين من جامعة كلية لندن و جامعة ام القرى. و أسمح لهؤلاء فقط بالاطلاع على البيانات المذكورة ضمن اطار البحث. ☐
- 4- أنا موافقة على تسجيل المقابلات الصوتية الخاصة بالبحث و أعلم انه سيتم التخلص منها بمجرد الانتهاء من البحث. ☐
- 5- أرغب بروية نتائج البحث ☐

اسم المشترك

التاريخ

التوقيع

الأخصائية التغذية: مي غباشي

التاريخ

التوقيع

الدكتور: حسان بخاري

التاريخ

التوقيع

Appendix E: questionnaires that are translated to Arabic

بحث الحياة الصحية

(نموذج جمع البيانات)

استبيان الرضاعة الطبيعية

هل تمت رضاعة الطفل بالرضاعة الطبيعية (من صدر الأم) ؟

نعم ()
لا ()

إذا لم يتم ارضاع الطفل رضاعة طبيعية ؛يرجى ذكر السبب :

-الطفل يعاني من مشكلة صحية ()
-الأم تعاني من مشكلة صحية ()
-حليب الأم لا يكفي ()
-أسباب عائلية ()

-غيرها ؛يرجى تحديدها

ما هو نوع الحليب الأول الذي تلقاه الطفل مباشرة بعد الولادة ؟

حليب الأم ()
الحليب المصنع (البالودر) ()

متى بدأت الرضاعة الطبيعية ؟

خلال الساعة الأولى بعد الولادة ()
بعد ساعة واحدة ()

إذا كانت الإجابة بعد ساعة واحدة من الولادة ، يرجى تحديد متى

ما هي مدة الرضاعة الطبيعية الحصرية (دون اعطائه أي نوع آخر من السوائل وبدون اعطائه أي حليب مصنع) ؟

عدد الشهور/عدد الأسابيع
كم هي مدة التغذية المختلطة (اعطائه الحليب المصنع "البالودر" بالإضافة إلى الرضاعة الطبيعية) ؟

عدد الشهور/عدد الأسابيع

عمر الطفل التقريبي عندما تم تزويده بمصدر خارجي للحليب

عدد الشهور/عدد الأسابيع
يرجى تحديد نوع الحليب:

.....

عمر الطفل التقريبي عندما يتم تزويده بتغذية تكميلية (بما في ذلك السيريلاك والأغذية اللينة) ؛ بدأت في:

عدد الشهور/عدد الأسابيع

يرجى تحديد ما هي الأطعمة التكميلية التي قدمتها لطفلك؟

1-
2-
3-

-هل استخدمت مصاصة لتهدئة الطفل؟

نعم ()
لا ()

استبيان سلوك أكل الطفل
يرجى قراءة العبارات التالية ووضع علامة على الفراغات الأنسب لسلوك تناول الطعام لطفلك.

الاسئلة :	دائما	غالباً	أحياناً	نادراً	أبداً
1- طفلي يحب الطعام					
2- طفلي يأكل أكثر عندما يشعر بالقلق					
3- طفلي لديه شهية كبيرة للطعام					
4- طفلي ينهي وجبته بسرعة					
5- طفلي مهتم بالطعام					
6- طفلي يطلب دائماً مشروب					
7- طفلي يرفض الأطعمة الجديدة في البداية					
8- طفلي يأكل ببطء					
9- طفلي يأكل أقل عندما يغضب					
10- طفلي يستمتع بتذوق الأطعمة الجديدة					
11- طفلي يأكل أقل عندما يكون متعب					
12- طفلي يطلب دائماً الطعام					
13- طفلي يأكل أكثر عند انزعاجه					
14- إذا سمحت لطفلي , سيأكل أكثر من اللازم					
15- طفلي يأكل أكثر عند القلق					
16- طفلي يحب مجموعة متنوعة من الأطعمة					
17- طفلي يترك الطعام في الطبق عند نهاية الوجبة					
18- طفلي يستغرق أكثر من 30 دقيقة لانتهاء وجبته					

الاسئلة :	دائما	غالبا	احيانا	نادرا	ابدا
19-لو تركت طفلي يختار الطعام , سياكل معظم الوقت					
20-طفلي يتطلع الى وجبات الطعام					
21-طفلي يشبع قبل ان ينتهي من تناول وجبته					
22-طفلي يتمتع بتناول الطعام					
23-طفلي يأكل اكثر عندما يكون سعيد					
24-طفلي صعب إرضاءه لكي يأكل					
25-طفلي يأكل اقل عند الانزعاج					
26-طفلي يشبع بسهولة					
27-طفلي يأكل اكثر عندما لا يكون لديه شيء اخر للقيام به					
28-حتى ان كان طفلي ممتلئا (يشعر بالشبع) فإنه يجد مساحة لتناول طعامه المفضل					
29-اذا اتحت الفرصة لطفلي, سيظل يشرب طوال اليوم					
30-لا يستطيع طفلي ان يتناول وجبته الرئيسية اذا كان قد تناول وجبة خفيفة قبلها مباشرة					
31-اذا اتحت الفرصة لطفلي سيظل يشرب دائما					
32-طفلي مهتم بتذوق الطعام الذي لم يتذوقه من قبل					
33-يقرر طفلي انه لا يحب الطعام حتى لو لم يتذوقه					
34-اذا اتحت الفرصة لطفلي سيظل الطعام بفمه دائما					
35-طفلي يأكل ببطء خلال الوجبة					

استبيان أسلوب الوالدين في التعامل مع الطفل بما يخص الطعام

يرجى قراءة العبارات التالية ووضع علامة في الفراغات المناسبة لإظهار كيفية التعامل معها

تغذية طفلك. من المهم أن نتذكر أنه لا توجد إجابات صحيحة أو خاطئة لهذه الأسئلة

؛ نحن مهتمون بما يشعر به الوالدان فعلا

الاسئلة:	دائما	غالبا	احيانا	نادرا	ابدا
1-اسمح لطفلي باختيار الاطعمة التي يجب تناولها في الوجبات					
2-اعطي لطفلي شيئا يأكله ليجعله يشعر بشعور أفضل عندما يشعر بالانزعاج					
3-انا اشجع طفلي لياكل الوجبة					
4-انا امدح طفلي اذا كان يأكل ما اقدمه له					
5-انا اقرر كم عدد الوجبات الخفيفة التي يجب ان يحصل عليها طفلي					
6-انا اشجع طفلي على تناول مجموعة متنوعة من الاطعمة					
7-من اجل ان اجعل طفلي يتصرف بشكل جيد , فإنني اعده بمكافأة من الطعام					
8-اقدم الطعام بطريقة جذابة لطفلي					
9-اذا اخطئ طفلي, اعاقبه بمنعه من الطعام					
10-اشجع طفلي على تناول كل الاطعمة التي اعدتها له					
11-اسمح لطفلي بالتجول عند تناول الطعام					
12-اشجع طفلي على تناول الاطعمة الجديدة التي لم يتذوقها من قبل					
13- اعطي لطفلي شيئا يأكله ليجعله يشعر أفضل عندما يكون قد أصيب					
14-اسمح لطفلي ان يقرر بنفسه عندما يود ان يتناول وجبته					
15- أعطي لطفلي شيئا للأكل إذا كان يشعر بالملل					
16-اسمح لطفلي أن يقرر ماذا يريد ان يأكل من الوجبات الخفيفة					
17-اقرر لطفلي وقت لتناول الوجبات الخفيفة					
18-استخدم الحلويات كإغراء لطفلي من أجل تناول الوجبة الرئيسية					
19-اشجع طفلي على الاستمتاع بالطعام					

الاسئلة:	دائما	غالبا	احيانا	نادرا	ابدا
20- احدد الاوقات التي يأكل فيها طفلي وجباته الغذائية					
21- أعطي لطفلي شيئا يأكله ليجعله يشعر أفضل عندما يكون قلقا					
22- اكافئ طفلي بالطعام عندما يحسن التصرف					
23- اسمح لطفلي ان يأكل بين الوجبات متى ما اراد ذلك					
24- اصر على طفلي ان ينهي وجبته عند تناول الطعام					
25- أعطي لطفلي شيئا يأكله ليجعله يشعر أفضل عندما يشعر بالغضب					
26- انا اقرر ما يأكله طفلي بين الوجبات					
27- انا امتدح طفلي واثنى عليه اذا تناول طعاما جديدا					

استبيان الأغذية المفضلة عند الاطفال

الاسئلة التالية تتعلق بمدى إعجاب طفلك بأطعمة مختلفة أو عدم رغبته في ذلك.

قائمة الأطعمة :	يحب تناوله جدا :	يحب : ولا يكرهه:	يكرهه: بشدة :	لم يجربه من قبل:
1-لحم البقر				
2-البرجر البقري				
3-لحم الخروف				
4-لحم الدجاج				
5-ناجيت الدجاج =مسحب الدجاج				
6-لحم الديك الرومي				
7-النقانق				
8-لحم السمك المقلي مثل: اصابع السمك المقلية				
9-لحم السمك العادي مثل: الهامور او الناجل او الحريد و غيرها				
10-التونة المعلبة				
11-البيض المسلوق				
12-البيض المقلي				
13-الخبز الابيض				
14-الخبز الاسمر				
15-وجبات خفيفة لذينة مثل: بسكويت الجبن				
16-الجبن المعالج بالحرارة مثل: جبنة كرافت				
17-الجبنة الصلبة مثل: جبنة الشيدر				
18-الجبنة الكريمة مثل: جبنة فيلادلفيا				
19-الحبوب (ليست مثلجة او محلاة) مثل: كورن فليكس				
20-الشيبس				
21-البروكولي				
22-الكرنب				
23-القرنبيط (الزهرة)				

قائمة الأطعمة:	يحب تناوله جدا:	يحبه:	لا يحبه ولا يكرهه:	يكرهه:	يكرهه بشدة:	لم يجربه من قبل:
24- الفاصوليا الخضراء						
25- الفطر = الماشروم						
26- البصل						
27- الجزر الابيض						
28- البازيلاء						
29- السلطة الخضراء مثل: الخس						
30- البطاطس الحلوة						
31- الذرة الحلوة						
32- الخيار						
33- الجزر الغير مطبوخ						
34- الجزر المطبوخ						
35- الفلفل الرومي الاحمر او الاخضر الغير مطبوخ						
36- الفلفل الرومي الاحمر او الاخضر المطبوخ						
37- الطماطم الطازجة الغير معلبة						
38- الطماطم المعلبة او صلصة الطماطم						
39- التفاح المخبوز او (التفاح المهروس بعد ان يتم طبخه)						
40- التفاح الطازج						
41- الموز						
42- البرتقال						
43- المندرين او اليوسفي						
44- العنب						
45- الشمام						
46- الخوخ او النكتارين						
47- الكمثرى او الاجاص						
48- التمر						
49- الفراولة						
50- المانجو						

قائمة الاطعمة:	يحب تناوله جدا:	يحب: يكرهه:	لا يحب ولا يكرهه:	يكرهه بشدة:	لم يجربه من قبل:
51-الكوي					
52-الاناناس					
53-الزبدة					
54-السمن او المرجرين					
55-القشطة					
56-البسكويت العادي مثل: بسكويت الشاي او بسكويت دايستف					
57-بسكويت الشوكولاتة					
58-الكيك					
59-الايس كريم					
60-المثلجات مثل:العصيرات المثلجة					
61-الحلى المصنوع من مشتقات الحليب					
62-الزبادي					
63-الكريسي او المقرمشات					
64-الشوكولاتة					
65-الفواكة المحلاة (المضاف عليها شيرة او سكر)					
66-الارز					
67-مطاعم الوجبات السريعة العالمية التي تقدم هدايا مع الوجبة مثل: مكدونالدز					
68-الوجبات السريعة التي لا تقدم هدايا مع الوجبة مثل: برقر كنج					
69- مطاعم البيترز مثل بيتزاهت و دومينوز					
70 مطاعم الوجبات السريعة المحلية مثل:البيك و كودو					

النشاط الرياضي

يرجى الإجابة بنعم إذا كان لديك المناطق التالية في منزلك أو حوله. أما إذا كان لديك منطقة ولكنها غير مناسبة لطفلك كي يلعب و يمارس التمارين فيها فيرجى الإجابة بـ " لا " .

غرفة الألعاب داخل المنزل	نعم او لا
غرفة التمارين الرياضية	نعم او لا
حوض الرمل	نعم او لا
الممشى	نعم او لا
مساحة مناسبة خارج المنزل كالفناء	نعم او لا

خلال الشهر الماضي , كم يوم من كل اسبوع و لكم من الوقت يقوم طفلك بممارسة الأنشطة التالية ؟

النشاط	أقل من مرة في الأسبوع نعم او لا	عدد الأيام؟	كم من الوقت كل يوم؟ يرجى وضع علامة في مربع واحد أو كتابة وقت إذا كان أكثر من ساعة واحدة يوميا
			الى 15 د 30-16 60-31 أكثر من ساعة
تلوين, رسم ,حرفة			
يلعب بالالعاب او الدمى او العاب الذكاء و حل الالغاز			
مشاهدة التلفاز			
استخدام الاجهزة الذكية			
اللعب على الكمبيوتر مثل البلايستيشن			
الجلوس والاستماع او الغناء			
القراءة			
اللعب داخل المنزل كالرقص و الجري وركوب الدراجات المنزلية او لعب الكرة داخل المنزل و استخدام العاب الكمبيوتر التي يقوم فيها الطفل بببزل مجهود بدني مثل (وي)			
اللعب في الحديقة او الفناء المنزلي			
المشاركة في أنشطة رياضية تجعل الطفل يتعرق مثل ركوب الدراجة و غيرها			

في الشهر الماضي كم مرة استخدم طفلك الوسائل التالية للتنقل من مكان لآخر (على سبيل المثال : الذهاب الى المحلات التجارية ,المدرسة/المجموعات كزيارة العائلة والاقارب او الذهاب للحديقة,,

كم من الوقت كل يوم؟ يرجى وضع علامة في مربع واحد أو كتابة وقت إذا كان أكثر من ساعة واحدة يوميا	كم مرة ؟	اقل من مرة في الاسبوع	
اكتر من ساعة	الى 15 د	30-16 د	60-31د

في الشهر الماضي ، كم عدد الأيام في كل أسبوع وكم مدة نشاط طفلك اليومي ؟

كم من الوقت كل يوم؟ يرجى وضع علامة في مربع واحد أو كتابة وقت إذا كان أكثر من ساعة واحدة يوميا	كم مرة؟	اقل من مرة في الاسبوع	
اكتر من ساعة	الى 15د	30-16د	60-31د

استبيان الطعام للطفل

الاطعمة	ابدا	اقل من مرة في الشهر	3-1 مرات في الشهر	عدد المرات في الاسبوع							اكثر من مرة في اليوم	عدد المرات في اليوم	الكمية التقريبية لكل حصة
1-الخبز الابيض	0	0.3	0.5	1	2	3	4	5	6	7	8	عدد الشرائح :	
2-الخبز الاسمراو الحبوب الكاملة	0	0.3	0.5	1	2	3	4	5	6	7	8	عدد الشرائح:	
3-المقرمشات /يسكوييت الجبن او الشابورة	0	0.3	0.5	1	2	3	4	5	6	7	8	العدد:	
4-حبوب الإفطار مثل الكورنفليكس	0	0.3	0.5	1	2	3	4	5	6	7	8	عدد ملاعق الطعام :	
ما هي الأنواع الرئيسية من حبوب الإفطار المستخدمة؟			ابدا		الماركة: الماركة								

الكمية التقريبية لكل حصة	عدد المرات في اليوم	أكثر من مرة في اليوم	عدد المرات في الأسبوع							1-3 مرات في الشهر	أقل من مرة في الشهر	أبداً	الاطعمة
عدد الحبات الصغيرة=		8	7	6	5	4	3	2	1	0.5	0.3	0	5-البطاطس المسلوقة او المخبوزة
عدد الحبات الصغيرة= او: عدد اكياس بطاطس مكشونالذو الصغيرة =		8	7	6	5	4	3	2	1	0.5	0.3	0	6-البطاطس المقليّة
عدد الاكياس الصغيرة=		8	7	6	5	4	3	2	1	0.5	0.3	0	7-الشيبس
عدد الشرائح=		8	7	6	5	4	3	2	1	0.5	0.3	0	8-الوافل
عدد الحبات الصغيرة=		8	7	6	5	4	3	2	1	0.5	0.3	0	9-البطاطس المشوية
عدد ملاعق الطعام= او عدد الاكواب=		8	7	6	5	4	3	2	1	0.5	0.3	0	10-المكرونّة المسلوقة
عدد ملاعق الطعام= او عدد الاكواب=		8	7	6	5	4	3	2	1	0.5	0.3	0	11-الارز المسلوقة او المقلي
عدد قطع الصدور= عدد قطع الافخاذ= عدد قطع الاجنحة= عدد قطع الناجيت=		8	7	6	5	4	3	2	1	0.5	0.3	0	12-بروست الدجاج المقلي المغطى باليقسماط
عدد ملاعق الطعام (مع استبعاد الخطار)=		8	7	6	5	4	3	2	1	0.5	0.3	0	13-صواني بالدجاج او الكاري
عدد قطع الصدور= عدد قطع الافخاذ= عدد قطع الاجنحة=		8	7	6	5	4	3	2	1	0.5	0.3	0	14-الدجاج المشوي
عدد الشرائح بحجم كف اليد=		8	7	6	5	4	3	2	1	0.5	0.3	0	15-لحم الخروف او البقر المشوي
عدد ملاعق الطعام (مع استبعاد الخطار)=		8	7	6	5	4	3	2	1	0.5	0.3	0	16-صواني بلحم الخروف او البقر بالكاري
عدد القطع بحجم كف اليد=		8	7	6	5	4	3	2	1	0.5	0.3	0	17-اللحم المشوي

الاطعمة	ابدا	اقل من مرة في الشهر	3-1 مرات في الشهر	عدد المرات في الاسبوع							اكثر من مرة في اليوم	عدد المرات في اليوم	الكمية التقريبية لكل حصة
18-برقر اللحم	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد القطع بحجم كف اليد=
19-برقر الدجاج	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد القطع بحجم كف اليد=
20-السجق	0	0.3	0.5	1	2	3	4	5	6	7	8		العدد بحجم شريحة كبيرة=
21-الكبد ، الكلاوي ومثيلاتها	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام=
22-الكبسة (لحم او دجاج مع الأرز)	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او مقدار كوب=
23-السمك المقلي او سمك بالزبدة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الشرائح بحجم كف اليد=
24-سمك مشوي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الشرائح بحجم كف اليد=
25-البيتزا	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الشرائح متوسطة الحجم=
26-البرقر النباتي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد شرائح البرقر بحجم كف اليد=
27-الجبن الأبيض مثل الفيتا	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام=
28-الجبن السائل مثل جبنة كرافت	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام=
29-الجبن الأصفر المصنع مثل جبنة الشيدر المعلبة	0	0.3	0.5	1	2	3	4	5	6	7	8		العدد القطع بحجم علبة الكبريت=
30-الجبن قليل الدهون	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام=
32-الصوص الأبيض او البشاميل	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام=
33-صوص كشنة الطماطم	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام=

الاطعمة	ابدا	اقل من مرة في الشهر	3-1 مرات في الشهر	عدد المرات في الاسبوع							اكثر من مرة في اليوم	عدد المرات في اليوم	الكمية التقريبية لكل حصة
34-الخضروات المعلبة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
35-الجزر	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
36-البازلاء , الفاصوليا الخضراء	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
37-الذرة والخضروات الحلوة المشكلة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
38-القرنبيط , الكوسة, الزهرة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
39-الملفوف الاخضر والسبانخ والكرنب	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
40-الطماطم	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد حبات الطماطم متوسطة الحجم=
42-الفاصوليا المخبوزة او المطبوخة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
43-الفول والبقول الأخرى	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
44-الفواكة المعلبة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
45-التفاح والكمثرى	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الحبات المتوسطة الحجم=
46-الموز	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الحبات المتوسطة الحجم=
47-البرتقال واليوسفي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الحبات المتوسطة الحجم=

الاطعمة	ابدا	اقل من مرة في الشهر	3-1 مرات في الشهر	عدد المرات في الاسبوع							اكثر من مرة في اليوم	عدد المرات في اليوم	الكمية التقريبية لكل حصة
48-الخوخ والحبيب	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الحبات المتوسطة الحجم= عدد شرائح الحبيب الرفيعة =
49-الفراولة والمانجو والكيوي	0	0.3	0.5	1	2	3	4	5	6	7	8		مجموع عدد الحصص= (حبة كيوي=1, شريحة مانجو=1, 15 فراولة =1)
50-البرقوق والكرز والعنب	0	0.3	0.5	1	2	3	4	5	6	7	8		مجموع عدد الحصص= (حبة برقوق=1, 10 حبات عنب او كرز =1)
51-الفواكة المجففة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
52-الفواكة المطبوخة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= او عدد الأكواب=
53-المكسرات	0	0.3	0.5	1	2	3	4	5	6	7	8		مجموع عدد الحصص= (10 حبات فستق او بندق=1, 7 حبات جوز =1)
54-الزبادي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الجرامات= (العلبة العادية تحتوي 150جم)
55-الحلويات الجاهزة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الجرامات= (العلبة العادية تحتوي 150جم)
56-الاييس كريم	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام= (كرة الايسكريم تحتوي 4 ملاعق)
57-حلويات المصاص	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد القطع متوسطة الحجم=
58- الكاسترد والمهلبية و الكريم كراميل و الساقودانه	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الطعام:

الاطعمة	ابدا	اقل من مرة في الشهر	3-1 مرات في الشهر	عدد المرات في الاسبوع							اكثر من مرة في اليوم	عدد المرات في اليوم	الكمية التقريبية لكل حصة
59-الكيك والكعك والمعجنات	0	0.3	0.5	1	2	3	4	5	6	7	8		مجموع الحصص من قطع الكعك الصغيره= (شريحة الكعك =1 بينما حجم المافين =2) العدد:
60-البسكويتات بالشوكولاتة	0	0.3	0.5	1	2	3	4	5	6	7	8		العدد:
61-البسكويتات السادة	0	0.3	0.5	1	2	3	4	5	6	7	8		العدد:
62-الشوكولا	0	0.3	0.5	1	2	3	4	5	6	7	8		مجموع الحصص= (الحجم الصغير =1 بينما الحجم العادي = 2)
63-الحلويات	0	0.3	0.5	1	2	3	4	5	6	7	8		مجموع عدد الحصص= (القطعة الصغيرة =1 بينما القطعة الكبيرة = 2)
64-رقائق البطاطس والوجبات الخفيفة	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكياس بالحجم العادي=
65-زبدة الفول السوداني	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الشاي=
66- المربى و الجلي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الشاي=
67- الزبدة و السمن	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الشاي=
68- الصوصات	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد ملاعق الشاي=
69- عصير الفاكهة النقي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
70- عصيرات الفواكه	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
71- عصيرات محتويه على فيتامين سي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
72- المشروبات الغازيه	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
73- المشروبات الغازيه منخفضة السعرات	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=

الاطعمة	ابدا	اقل من مرة في الشهر	1-3 مرات في الشهر	عدد المرات في الاسبوع							اكثر من مرة في اليوم	عدد المرات في اليوم	الكمية التقريبية لكل حصة
74-القهوة والشاي	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
75-المشروبات المضاف اليها الحليب مثل (الحليب بالفاراولة)	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
76-الحليب كامل الدسم	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
77- الحليب قليل الدسم	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=
78-الماء	0	0.3	0.5	1	2	3	4	5	6	7	8		عدد الاكواب=

Appendix F: Patient Information Sheet for the qualitative study and the pilot intervention



منشور المشاركه للآباء والأمهات
رقم معرف موافقة لجنة الأخلاقيات البحثية في جامعة لندن
PE017



برنامج دكتوراه بعنوان " : حياة صحية " .. الجزء 2
لدراسة محددات زيادة الوزن في المملكة العربية السعودية وتحسن نمط حياة
القسم: معهد صحة الطفل بجامعة لندن.
اسم وتفاصيل الاتصال الخاصة بالباحث : مي غياشي
رقم الهاتف : [REDACTED]
البريد الإلكتروني [REDACTED]

اسم وتفاصيل الاتصال بالباحث الرئيسي : الدكتورة جولي لانيجان
[REDACTED]
البريد الإلكتروني [REDACTED]

دعوة

نود أن ندعوك أنت وطفلك للمشاركة في برنامج الحياة الصحية. توفر لك هذه النشرة معلومات حول البرنامج و الهدف منه، و البيانات المطلوبة للتسجيل. يرجى قراءة المعلومات أدناه ، ولا تترددى ابدا في الاستفسار عن أي أمور قد تكون غير واضحة لك ، كما يسرنا التواصل معك إذا كنت ترغبين في تزويدك بمعلومات إضافية. إنه قرارك الخاص فيما إذا كنت ترغبين في أن تشاركي أنت وطفلك في هذا البرنامج

ما هو الغرض من برنامج الحياة الصحية؟

الهدف منه هو معرفة نمط الحياة للطفل و الاسره و معرفة أيضا كيف يمكن أن تؤثر العوامل الخارجية على العادات الغذائية بن الأطفال في سن ما قبل المدرسة و الذين تتراوح أعمارهم بن 3-6 سنوات في مدينة مكة المكرمة ، المملكة العربية السعودية. تم تصميم برنامج "الحياة الصحية" لمساعدة الأمهات و مقدمي الرعاية على اتخاذ خيارات صحية ونمط حياة مناسب لأطفالهم قبل سن المدرسة. نأمل أن نكتشف من البرنامج العوامل المرتبطة بتكوين العادات الغذائية المؤدية لزيادة الوزن عند الأطفال و معالجتها منذ بداية نشوؤها

لماذا نقوم بعمل هذا البرنامج ؟

أشارت الدراسات الحالية إلى أن العادات الغذائية تتكون في مرحلة الطفولة المبكرة وأن هذه العادات تؤثر تباعا على خيارات نمط الحياة في المستقبل وقد تزيد من خطر السمنة او الإصابة بالامراض المزمنة كالسكري و القلب لا سمح الله. أجريت دراسات قليلة في المملكة العربية السعودية و لذلك فأنا بحاجة الى مثل هذه البرامج ، و التي بالتالي ستوفر معلومات أساسية للوقاية من السمنة أثناء الطفولة و ما بعدها

لماذا تم اختيار طفلي؟

تتم دعوة الأطفال المعرضين لزيادة الوزن من أجل مشاركة في هذا البرنامج

كيف يتم عمل برنامج الحياة الصحية؟

بعد شرح الدراسة لك في روضة "حديقة الطفل" ، سيطلب منك التوقيع على نموذج موافقة ، مما يسمح لك وطفلك بالمشاركة في هذه الدراسة و بالطبع سيتم تزويدك بنسخة من نموذج الموافقة . سوف تتطلب دراسة الحياة الصحية قياساً لك أنت وطفلك في ثلاث مناسبات كالتالي:

- في بداية الدراسة

- في نهاية الدراسة

- بعد 6 أشهر من اجل المتابعة

من اجل مساعدتنا ، نود منك استكمال بعض الاستبيانات حول خلفيتك وعن عادات طفلك الغذائية ونمط الحياة و مستوى النشاط البدني لطفلك

الأطفال

سيتم تقسيم الأطفال المشاركين وأولياء أمورهم في واحدة من مجموعتين. ستشارك إحدى المجموعتين في برنامج يهدف إلى مساعدة الآباء والأمهات والأطفال على تبني أسلوب حياة أكثر صحة (مجموعة البرنامج). سيتم تزويد المجموعة الأخرى بالرعاية المعتادة (المجموعة

(الضابطة). تشمل الرعاية المعتادة الدروس التي تعلم الأطفال أساسيات الحروف والكلمات والأرقام. سيتم تحديد هذه المجموعات بواسطة الكمبيوتر بشكل عشوائي. سيتم إجراء جميع القياسات في بداية الدراسة وتكرر بعد 3 أشهر وأيضاً بعد 6 أشهر بعد الانتهاء من البرنامج من أجل مقارنة النتائج وتحديد التغييرات البرنامج سيستمر لمدة 12 أسبوعاً (أي خلال الفصل الدراسي الأول). حيث يتعلم الأطفال عن التغذية من خلال المشاركة في جلسات ممتعة في رياض الأطفال ، مثل التلوين في الفواكه والخضروات و المشاركة في اعداد الوجبات الصحية و اللعب. سوف يشاركون أيضاً في النشاط البدني من خلال التحرك مع ايقاعات الاناشيد المألوفة. سيتم تزويد الأطفال بالألعاب والألعاب التي يمكن استخدامها في المنزل لمساعدتهم على تذكر ما تعلموه

الأمهات

سنرسل لك منشورا تثقيفيا مرة كل أسبوع لمدة 3 اشهر عبر WhatsApp على هاتفك. تهدف هذه المنشورات إلى مساعدتك على معرفة الأمور التي تجعل أسلوب الحياة صحي. في كل منشور ستجدين صفحة نشاط مختصرة. تساعدك هذه الأنشطة على تحديد أهداف صغيرة وتبني أسلوب حياة صحي. سنرسل لك أيضاً مقطع فيديو قصيراً كل أسبوع ، حيث نشرح لك المنشور بشكل مختصر. قد تستغرق قراءة المواد والاستماع إليها حوالي 15-20 دقيقة ، وقد يستغرق النظر في صفحة النشاط حوالي 10 دقائق. ايضاً سوف ندعوك لحضور جلسة مناقشة شهرية وجهاً لوجه حيث يمكنك إخبارنا كيف تجدين البرنامج وتستطيعين ان تطرحي أي أسئلة. سوف تحصلن على أدوات الطبخ (القلاية الهوائية) لمساعدتك على إعداد وجبات.

القياسات

إذا وافقت على المشاركة ، فسنطلب منك اخذ قياسات بسيطة وغير مؤلمة وغير ضارة بأي حال من الأحوال مثل:

- أ) قياس الطول والوزن ومحيط الخصر لطفلك
- ب) إكمال استبيان حول العادات الغذائية لطفلك قبل و بعد البرنامج
- ج) اطرح بعض الأسئلة حول صحة طفلك والأنماط الغذائية والنشاط البدني والتاريخ العائلي لاي امراض وما إذا كان يتم تناول أي أدوية
- د) التحدث معك عبر الهاتف او مقابلتك في بداية البرنامج. اذ نود إجراء دردشة معك لفهم أفكارك حول السمنة لدى الأطفال والعوامل التي تشعر أنها قد تساعد أو تمنعك من تبني عادات نمط الحياة الصحية. قد تستغرق هذه المقابلة حوالي 15-25 دقيقة
- و) مهاتفتك او مقابلتك مرة أخرى في نهاية البرنامج لإجراء مناقشة موجزة أخرى معك لمعرفة رأيك في البرنامج وسماع تعليقاتك واقتراحاتك. قد يستغرق هذا حوالي 10-15 دقيقة.

إذا وافقت ، نود تسجيل الصوت لهذه المقابلات. إذا كنت لا توافق على تسجيل المقابلات الصوتية ، فلا يزال بإمكانك المشاركة في الدراسة.

قد يستغرق ملء الاستبيانات وأخذ قياسات جسمك حوالي ساعتين. ستجري القياسات في غرفة ملحوظة خاصة وستكون نتائج الدراسة سرية. ود أن نؤكد لكم أنه قرارك إكمال الاستبيانات وأنه يمكنك رفض المشاركة في أي أو جميع الأنشطة إذا كنت ترغبين في ذلك ، يمكنك الحضور أثناء إجراء قياسات الجسم في طفلك. ومع ذلك ، ليس من الضروري لك أن تكون حاضراً حيث سيرافق الأطفال طاقم رياض الأطفال

هل يجب علي و على طفلي أن نشارك؟

الأمر متروك لك لتقرري الانضمام إلى برنامج الحياة الصحية. إذا وافقت على المشاركة ، فسنطلب منك التوقيع على نموذج الموافقة. قد ترفض المشاركة في أي جانب من جوانب الدراسة في أي وقت. تستطيعين الانسحاب في أي وقت دون إبداء سبب. لن يؤثر هذا على مستوى الرعاية التي يتلقاها أنت أو طفلك.

ما هي العيوب والمخاطر المحتملة للمشاركة؟

لا توجد عيوب محتملة أو أي مخاطر متوقعة من المشاركة على الإطلاق فالبرنامج امن جدا وبسيط

ما هي الفوائد من المشاركة؟

المعلومات التي نحصل عليها من هذه الدراسة ستساعد في فهمنا لعوامل خطر السمنة لدى الأطفال ولمساعدتنا في تصميم برامج مصممة خصيصا للمساعدة على بناء مجتمع صحي

ماذا لو حدث خطأ ما؟

ليس من المتوقع حدوث أي خطأ فالبرنامج معتمد من قبل لجنة أخلاقيات البحث في كل من المملكة العربية السعودية والمملكة المتحدة ومع ذلك ، إذا كان لديك أي مشكلة ، يرجى التحدث إلى الباحث على [REDACTED] الذي سيبدل قصارى جهده على حل أي امر قد يواجهك

شكاوي

إذا كانت لديك أي شكوى حول الطريقة التي عوملت بها ، فيرجى الاتصال بالباحثة الرئيسية مي غباشي في المقام الأول على [REDACTED] إذا كنت ترغب في تقديم شكوى رسمية فاتصل بالدكتور. حسان بخاري من جامعة أم القرى ، كلية العلوم الطبية التطبيقية ، قسم التغذية السريرية على [REDACTED] وبالإضافة إلى ذلك ، يحق لك المطالبة بالتعويض في محكمة قانونية الحقيقة ان أي آثار سلبية خطيرة هي امور ليست محتملة ابداف البرنامج امن جدا. ومع ذلك ، في حالة حدوث أي إصابة ، سوف نتصل بك وسيحصل طفلك على الرعاية الصحية المناسبة. تغطي وزارة الصحة في المملكة العربية السعودية كافة المواطنين.

هل تبقى مشاركتي في دراسة الحياة الصحية سرية؟

نعم بالتأكيد، إذا وافقت على المشاركة في هذه الدراسة ، فإن المعلومات التي تم الحصول عليها أثناء مشاركتك في البرنامج وكذلك السجلات الصحية ذات الصلة ستبقى سرية للغاية في جميع الأوقات. لن يتم التعرف عليك في أي تقارير أو منشورات . سيتم الاحتفاظ بالمعلومات بشكل آمن على الورق وإلكترونيًا بموجب أحكام اللائحة العامة لحماية البيانات لعام 2018 م لن يتم نقل اسمك إلى أي شخص آخر خارج فريق البحث أو الراعي الذي لا يشارك في التجربة. سيتم تخصيص رقم مشاركتك لك ، والذي سيتم استخدامه كرمز لتحديد هويتك ضمن اطار غرض البحث العلمي

ماذا سيحدث إذا لم أكن أرغب في متابعة دراسة الحياة الصحية؟

يمكنك الانسحاب في أي وقت دون أي عواقب ، ودون التأثير على مستوى الرعاية التي يتلقاها طفلك. لن يتم تضمين بياناتك وسيتم إتلافها بشكل مناسب

ماذا سيحدث لنتائج برنامج الحياة الصحية؟

سيتم نشر نتائج الدراسة في مجلة طبية أو تقديمها في مؤتمر علمي. ستكون البيانات مجهولة ولن يتم تحديد أي من المشاركين في التجربة في أي تقرير أو منشور. إذا كنت ترغب في رؤية النتائج أو المنشور ، فيرجى سؤال الباحث الرئيسي عن ذلك

إشعار خصوصية حماية البيانات

تنويه: ستكون الجهة المسؤولة عن حماية البيانات لهذا المشروع هي جامعة لندن ذلك يشمل معالجة البيانات الشخصية ، و يمكن أيضاً الاتصال بمسؤول حماية البيانات في

UCL على

data-protection@ucl.ac.uk.

ستتم معالجة بياناتك الشخصية للأغراض الموضحة في هذا الإشعار. يمكن العثور على مزيد من المعلومات حول كيفية استخدام UCL للمعلومات المشاركين في إشعار الخصوصية "العام" الخاص بنا من خلال الموقع

: <https://www.ucl.ac.uk/legal-services/privacy/participants-health-and-carerresearch-privacy-notice>

DPA 2018 (و GDPR) يتم توفير المعلومات المطلوبة للمشاركين بموجب قانون حماية البيانات الأساس القانوني المستخدم لمعالجة البيانات الشخصية للفئة الخاصة سيكون للأغراض العلمية والتاريخية أو للأغراض الإحصائية و ستتم معالجة بياناتك الشخصية طالما كانت مطلوبة لمشروع البحث بشكل سري جداً. سنعمل على إخفاء الهوية الشخصية للبيانات الشخصية التي تزودنا بهاو عدم الكشف عن اسمها المستعار ، وسنسعى لتقليل معالجة البيانات الشخصية إلى الحد الأدنى حيثما أمكن ذلك. إذا كنت مهتماً بكيفية معالجة بياناتك الشخصية ، أو إذا كنت ترغب في الاتصال بنا بشأن حقوقك ، فيرجى الاتصال بـ UCL في المقام الأول على

data-protection@ucl.ac.uk

من يقوم بتنظيم وتمويل البحث؟

حصل الباحث على أموال من خلال منحة دراسية لجامعة لندن ، من قبل جامعة أم القرى في المملكة العربية السعودية. الراعي الثاني شركة الدار المكية في المملكة العربية السعودية.

من الذي راجع برنامج الحياة الصحية؟

تمت مراجعة هذا البرنامج وإعطاء رأي إيجابي عليه من قبل لجنة أخلاقيات البحث العلمي مزيد من المعلومات وتفاصيل الاتصال إذا كنت بحاجة إلى أي معلومات إضافية أو لديك أي مخاوف أثناء المشاركة في الدراسة ، فيرجى الاتصال بأحد الأشخاص التاليين: باحث رئيسي الاسم مي غباشي الرقم : [REDACTED] مشرف الاسم د.حسان بخاري هاتف. الرقم : [REDACTED] إذا قررت أنك ترغب في المشاركة ، فالرجاء قراءة وتوقيع نموذج الموافقة. سيتم إعطاؤك نسخة من ورقة المعلومات هذه ونموذج الموافقة على الاحتفاظ بها. يمكنك الحصول على مزيد من الوقت للتفكير.

شكراً لأخذ الوقت الكافي لقراءة هذا المنشور للمشاركة في البرنامج

Appendix G: Consent form for participation in the qualitative study and the pilot intervention

رقم الدراسة المعتم
17PE01

رمز المشترك الخاص

إقرار الموافقة على المشاركة

عنوان البحث : زيادة الوزن في المملكة العربية السعودية : بين المسببات و وسائل الوقاية

برنامج الحياة الصحية: التطبيق و الدراسة النوعية

اسم البحث: مي عادل غباشي

يرجى وضع علامة امام الفقرات التالية:

- ☐ 6- اقر بأني قرأت وفهمت نشرة شرح البحث (المعدة بتاريخ 20-يونيه-2019) الخاصة بالدراسة المذكورة أعلاه. و قد اتيتحت لي الفرصة للتفكير و طرح الأسئلة و الحصول على الإجابات الشافية.
- ☐ 7- لقد فهمت ان مشاركتي هي امر اختياري و ليس اجباري ابدأ و انه يحق لي الانسحاب متى شئت دون ذكر الأسباب و دون أي عواقب سواء علي شخصيا او على طفلي.
- ☐ 8- لقد فهمت ان المعلومات التي سأذكرها سيطلع عليها فقط الباحثين المعتمدين من جامعة كلية لندن و جامعة أم القرى. و أسمح لهؤلاء فقط بالاطلاع على البيانات المذكورة ضمن اطار البحث.
- ☐ 9- أنا موافقة على تسجيل المقابلات الصوتية الخاصة بالبحث و أعلم انه سيتم التخلص منها بمجرد الانتهاء من البحث.
- ☐ 10- أأرغب بروية نتائج البحث
- ☐ 11- أوافق على المشاركة في البحث المذكور أعلاه

اسم المشترك

التاريخ

التوقيع

الأخصائية التغذية: مي غباشي

التاريخ

التوقيع

الدكتور: حسان بخاري

التاريخ

التوقيع

Appendix H: The Topic Guide for the qualitative study

العنوان	السؤال الرئيسي	الأسئلة التابعة
الرؤية الشمولية الخاصة بالوزن المثالي ونمط الحياة الصحي	-ماهي نظرتك لنظام الحياة الصحي؟ -ما هو رأيك في اوزان الأطفال هذه الايا؟	-كيف تصفين نظام الحياة الصحي و ماذا عن النشاط البدني؟ -ماذا عن طفلك بشكل خاص؟ -هل تعتقدين ان السمنة او النحافة تعتبر أمور يجب اخذها بعين الاعتبار؟ -ماذا بخصوص طفلك؟ هل تعتقدين ان وزنه مثالي ام ناقص قليلا ام زائد ؟
الرؤية الشمولية الخاصة بالعوامل المؤثرة على زيادة الوزن عند الأطفال	-من خلال خبرتك , لماذا باعتقادك يكسب الأطفال المزيد من الوزن ؟ -ماذا عن طفلك بشكل خاص ؟ ما الذي يؤثر في وزنه ؟	-هل باعتقادك ان الاكل و الوزن مرتبطان ببعض؟ - ماذا أيضا قد يكسب الأطفال وزنا زائدا؟ أي شيء اخر ؟ مثلا قلة النشاط البدني ؟ -هل هناك شيء معين تعتقدين انه يؤثر بوزنه؟ أي شيء متعلق مثلا بنوعية طعامه او نشاطه البدني ؟ -هل تريدونه ان يتناول أصناف معينة ؟ هل تريدن ان يكون نشاطه البدني مختلفا؟ -هل هناك تأثيرات خارجية من بعض الأطراف كالاقرباء او الأصدقاء؟
-القابلية للتغيير و مدى الاستعداد و التهيء للمشاركة في برنامج يهتم بنحسين نمط الحياة	-ما رأيك بالمشاركة في برنامج يهدف لتحسين العادات الغذائية و نمط الحياه للأطفال في السعودية؟ -الى أي مدى ستكون متحمسة للتسجيل في مثل هذا البرنامج؟ -هل لديك أي إضافات او ملاحظات؟	-هل التسجيل في مثل هذه البرامج امر مشجع بالنسبة لك؟ -ما الذي قد يسهل عليك على المشاركة في مثل هذه ابرامج؟ و أيضا مالعوامل التي قد تعيق عملية تسجيلك ؟ -هل تستطيعين التفكير في أي جانب لربما لم نقم بتغطيته اثناء هذا اللقاء؟

Appendix I: The topic guide for the initial semi-structure interview (part of the PPI)

الأسئلة المساعدة لعمل المقابلات الشخصية أثناء الزيارة الاستكشافية للسعودية

- هل تعتقد ان من المهم تأسيس برنامج للأطفال و الأمهات حيث يهدف الى مساعدتهم على تبني عادات صحية و بالتالي التقليل من خطر الإصابة بالسمنة؟
- اذا اتاحت لك الفرصة فهل ستشاركين؟ و ما هي العوامل التي ستسهل عليك المشاركة ؟
- هل تفضلين ان تأتي مع طفلك الى مقر البرنامج أسبوعيا و لمدة 3 اشهرام تفضلين المشاركة عن بعد بينما يشارك طفلك بشكل شخصي في البرنامج؟
- اذا كنتي تفضلين القدوم مع طفلك فأأي الأوقات التالية مناسبة لك (الصباح , العصر , المساء) ؟
- اذا كنتي تفضلين المشاركة عن بعد فماهي وسائل التواصل المناسبة لك؟
- ما هي الخصائص التي تجعل من أي وسيلة تواصل مريحة ومقبولة بالنسبة لك؟
- ماهي العادات الغذائية لدى طفلك و التي تودين ان تتغير؟

Appendix J: supplementary material for mothers (Air fryer)

Air fryer - Low-fat frying with air | Philips



Appendix K: List of Healthy snacks prepared during the intervention sessions

- 1-Fruit salad
- 2-Vegetable salad
- 3-Cucumber and Carrots sticks with hummus dipping
- 4-Yogurt ice cream
- 5-Chicken Tacos with vegetable
- 6-Egg muffin with vegetable
- 7-Rainbow fruit skewers
- 8-Happy Cheese face sandwich with vegetables
- 9- Yogurt shake and fruit salad
- 10-Cucumber bites (with cheese and carrots)
- 11-Mini fruit pizzas
- 12- Vegetable pizza

Appendix L: Supplementary material for children (toys)

Reward charts

Reward stickers

Fruits and vegetable model (fingers puppet)

Fruits and Vegetable models made of plastic

Fruit and vegetable coloring book

Fruit and vegetable model with cutting board

Appendix M: Assessment of child's ability to join the intervention session

لا	نعم	هل الطفل بحاله جيدة كافية للمشاركة في البرنامج اليوم؟
لا	نعم	هل يعاني الطفل من أي عارض صحي اليوم؟
لا	نعم	هل من الامن بالنسبة للطفل ان يشارك في النشاط البدني اليوم؟
لا	نعم	هل اصبح الطفل يعاني من أي نوع من الحساسية؟

Appendix N: Leaflet adapted from the Trim Tots intervention

المنشورات التثقيفية

توازن الطاقة

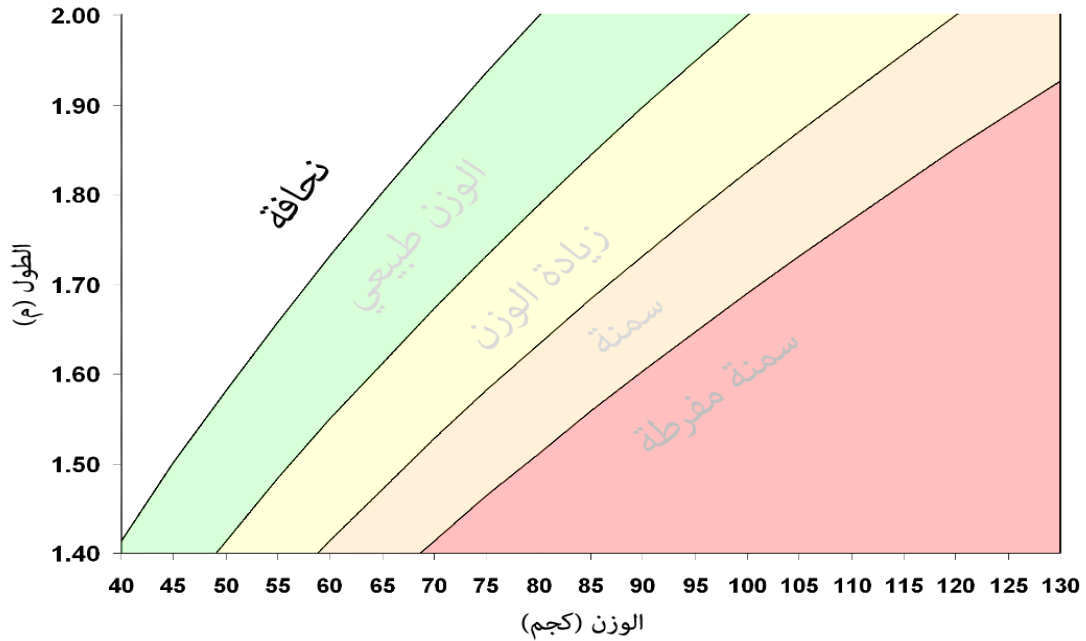
للحصول على وزن صحي والمحافظة عليه فإن ذلك يعتمد على توازن الطاقة في الجسم وهو شيء يجب علينا جميعاً معرفته وأن نجعله هدفاً لنا. والمفتاح الأهم للحصول على وزن صحي هو محاولة إيجاد التوازن ما بين الطاقة المدخلة إلى الجسم والطاقة الناتجة من الجسم.

تحديداً نريد أن نوازن ما بين كمية الطاقة التي ندخلها عن طريق الأكل والشرب مقابل كمية الطاقة التي تستهلكها أجسامنا لكي تبقى نشيطة.

كيف أعرف أن وزني صحياً ؟

معدل كتلة الجسم هي طريقة تختصر لنا ما إذا كانت أوزاننا متناسبة مع أطوالنا أم لا. فإذا كنت تعلم قياس وزنك وطولك ، يمكنك معرفة معدل كتلة جسمك عن طريق الجدول الموضح أدناه للبالغين. وهناك جداول أخرى خاصة للأطفال (كتاب سجل الأطفال). انظري الى الرسم البياني و ستلاحظين أنه مقسم إلى عدة فئات.

مؤشر كتلة الجسم (BMI)



إذا كان معدل كتلة جسمك ما بين 18.5 – 24.9 ستكون من الفئة ذات الوزن المثالي. أما إذا كان أكبر من 25، فهذا يعني أن هناك طاقة زائدة في جسمك على هيئة دهون. ولكي يستعيد جسمك التوازن الصحي يجب أن :

- تزيد من النشاط البدني
- تتناول وجبات متوازنة، صحية وقليلة الدهون

هل جسمك على شكل تفاحة أم كمثرى ؟



بإضافة إلى أهمية الوزن الصحي، فإن الشكل الخارجي للجسم مهم أيضًا.

فالوزن الزائد في منطقة البطن، خاصة إذا كان محيط الوسط أكبر من محيط الخصر، غالبًا تسمى هذه بشكل (التفاحة)، وهذا يزيد من احتمالية إصابتنا بمرض السكري وأمراض القلب.

للتقليل من هذه الاحتمالية، يجب على النساء الحرص على أن يكون محيط الخصر أقل من 80 سم (32 إنش) وعلى الرجال أن يكون أقل من 94 سم (37 إنش).

ماذا سأستفيد ؟

زيادة على قدرة التحكم بأوزاننا، هناك فوائد أخرى كثيرة ناتجة من الأكل الصحي والنشاط البدني، منها :

لماذا علينا أن نكون نشيطين ؟	لماذا علينا تناول الطعام الصحي ؟
النشاط يساعد في : • التحسين من وظائف الدماغ • تقوية العظام • انخفاض الكوليسترول • يجعل الأوعية الدموية صحية أكثر • يقلل من احتمالية إصابتنا بالإنفلونزا ونزلات البرد • يقوي القلب • يقلل من احتمالية الإصابة بالسرطانات • يجعلنا أقل عرضة للإصابات • يقوي الكبد • يجعلنا أقوىاء	نستطيع زيادة فرصة: • العيش لمدة أطول بصحة وعافية • الشعور بالراحة • النوم جيداً • تحسين الخصوبة • انخفاض معدل ضغط الدم • انخفاض الكوليسترول وفي المستقبل التقليل من الإصابة بـ: • أمراض القلب • الجلطات • مرض السكري النوع الثاني • بعض أنواع السرطانات • آلام المفاصل وبعض أمراض العظام

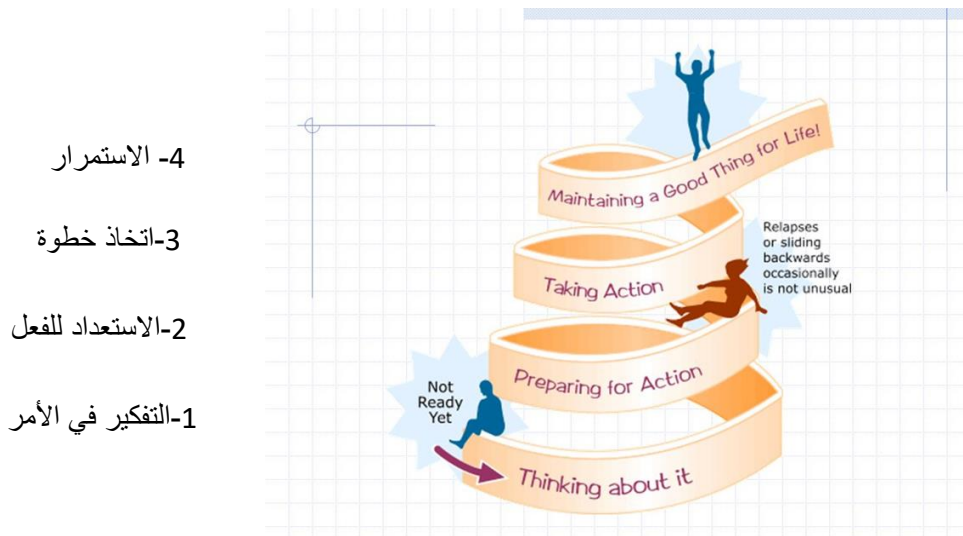
صفحة النشاط

الاستعداد للتغيير

ما هو شعورك نحو التغيير ؟

هل انتِ مستعدة لجعل عاداتك الغذائية ونظام حياتك أكثر صحة، هل هو سهل التغيير؟

الصورة أدناه توضح المراحل المختلفة لاستعداد الناس للتغيير



أين موقعك انت في هذه الصورة ؟

فكري في ثلاثة أشياء من الممكن أن تفعليها لكي تجعل نظام حياة عائلتك أكثر صحة وانظري الى أي فئة تنتمي إليها أنتِ وعائلتك. مثال، من الممكن أن تجد سهولة في فعل بعض التغييرات مثل اغلاق التلفاز عند تناول الطعام ولكن ستواجهين صعوبة في التوقف عن تناول قطعة الشوكولا في المساء. إذا كنتِ غير مستعدة للتغيير فكري في ما يمكن أن يكون السبب.

طرق الطبخ



الطبخ في المنزل يسمح لك بالتحكم في طريقة تحضير الطعام ويساعد على التقليل من كميات الدهون المستخدمة في الطبخ. تغيير طريقة تحضيرك للأكل لا تعني الاستغناء عن النكهة اللذيذة والمذاق الشهى. هناك عدة طرق لطبخ طعام ذا نكهة مشهية ولذيذة بدون إضافة كمية كبيرة من الدهون الغير لازمة.

أذاً من الممكن للطعام أن يكون صحياً ولذيذاً في نفس الوقت.

هنا بعض الطرق البسيطة لتحضير وجبات صحية:

- استخدام أواني ضد الالتصاق ولا تحتاج إلى إضافة زيوت
- استبدال الدهون الحيوانية بزيوت نباتية غير مشبعة مثل زيت الكانولا أو زيت الزيتون
- استخدام رذاذ الزيت بدلاً من سكب الزيت في الأواني
- نزع الجلد من الدجاج قبل الطهي
- اختيار قطع اللحم منزوعة الدسم أو إزالة الشحم (الدهون الظاهرة) منها.
- سلق الدجاج واللحم. انتظري حتى يبرد ثم ازيلى الدهون التي تظهر على سطح الماء
- استخدام المايكروويف كطريقة طبخ لأنه يحافظ على العناصر الغذائية من فقدان لأنه يطبخ سريعاً ويسخن الطعام في أقل وقت ممكن
- استخدام البخار والشوي في الطبخ للتقليل من استخدام الدهون والمحافظة على العناصر الغذائية قدر المستطاع
- الابتعاد عن القلي بالزيت. بدلاً من ذلك جرب طريقة الخبز أو القلي الهوائي
- استبدال الكريمة بمنتجات الألبان قليلة الدسم مثل لبن قليل الدسم أو حليب قليل الدسم
- الابتعاد عن إضافة الملح. تعويض النكهة بإضافة البهارات والاعشاب مثل الكزبرة، الريحان و الزعتر. ويمكنك أيضاً استخدام عناصر أخرى مميزة مثل الثوم والزنجبيل والفلفل والليمون

صفحة النشاط

وضع أهداف ذكية

إذا قررت تغيير شيء ما في حياتك، فواحدة من أفضل الطرق هي أن تضعي أهداف واقعية صغيرة. الهدف الذكي يكون دقيق، قابل للقياس، يمكن تحقيقه، ذو صلة، محدد وقته وقادر على مساعدتك للتغيير. هنا طريقة لكيف يمكنك ذلك:

نوع الهدف	مثال ضعيف	مثال قوي
دقيق	تناول مشروبات صحية	شرب عصيرات فواكه مخففة بدلاً من المشروبات الغازية
قابل للقياس	التقليل من تناول المقرمشات	تقليل تناول المقرمشات إلى حفنة واحدة للوجبة مره واحده في الأسبوع
يمكن تحقيقه	استخدام السلالم فقط (لا يمكن تطبيقه اذا كنت تعيش في طابق واحد)	استخدام السلالم بدلاً من المصاعد والسلالم الكهربائية في الأسواق
ذو صلة	الإكثار من تناول التفاح	تناول حصة فواكه مع كل وجبة
محدد الوقت	الإكثار من السباحة	الذهاب للسباحة مساء كل سبت في هذا الشهر

لا تنسي مكافئة نفسك (بشيء غير الأكل) عند تحقيق هدف، مثلاً التمتع في الحديقة أو رحلة سباحة مع العائلة

نظام صحي متوازن



لاتتبع نظام غذائي صحي، ببساطه يمكنك الاستمتاع بالخيارات الوفيرة من الأكل الصحي. يمكن تقسيم الأكل الذي تتناولينه إلى مجموعات غذائية (انظري للصورة في الأعلى) واستخدمي هذه المجموعات لموازنة نظامك الغذائي.

ما أهمية النظام الغذائي الصحي؟

يمكن للنظام الغذائي الصحي أن يساعد في التحكم بالوزن، تحسين الصحة العامة والتقليل من خطر الإصابة بالسمنة، أمراض القلب، السرطانات، السكري، وهشاشة العظام. و يمكن أن يحافظ على صحة بصرك، شعرك، بشرتك و أظافرك و يجعلها في حالة جيدة.

ماذا عن تغذية ابني؟

الأطفال الصغار يحتاجون غذاء صحي ومتوازن مثلهم مثل البالغين ولكن الفرق في كمية الطعام. وللمحافظة على صحة الاطفال، يجب علينا أن ننوع في خيارات الطعام من المجاميع الغذائية الأربعة (اقتصادي من اختيارات مجموعة الدهون). ويجب على الاطفال تناول وجباتهم بانتظام مع إضافة وجبات خفيفة.

الكربوهيدرات النشوية (يجب أن تكون موجودة في كل وجبة)

الحبوب، الخبز، المعكرونة، الأرز والبطاطس. هذه الأغذية تمد الجسم بالطاقة، الألياف و فيتامينات ب . قدمي تشكيلة من الحبوب الكاملة و البيضاء للأطفال الصغار.

الفواكه والخضروات (يفضل تناول 5 حصص منها كل يوم)

جميع أنواع الفواكه والخضروات متضمنة الطازجة، المعلبة (محفوظة في عصير طبيعي وليس شراب مركز)، المجمدة او المجففة. حاولي عدم طبخها كثيرًا أو وضع الدهون والسكر عليها. 150 مل من العصير=حصّة واحدة. للأطفال تحت سن الخامسة، خففي مقدار العصير الى ما يعادل وحدة من العصير مقابل 10 وحدات من الماء. هذه الأغذية تزود الجسم بالفيتامينات خاصة فيتامين ج و الألياف

اللحوم وبدائل اللحوم، الأسماك، البيض، الفاصولياء والبازلاء (تناولي حصتين منها يوميًا)

اللحم الطري (منزوع الدسم)، الدواجن(منزوعة الجلد)، السمك، الفاصولياء، البازلاء، المكسرات و الجوز، البذور والبيض. حاولي طبخها بالبخار، الشواء أو السلق. وتجنبي إضافة الدهون أو الزيت في الطبخ. هذه الأغذية تزود الجسم بالبروتين، الحديد و الزنك.

الحليب ومنتجات الألبان (تناولي 3 حصص منها يوميًا)

الحليب، اللبن، الجبن و الجبن الأبيض. اختاري الحليب قليل أو منزوع الدسم إذا كان هدفك تنزيل الوزن. الأطفال إلى سن الثانية يمكنهم شرب حليب كامل الدسم. هذه المجموعة تزود الجسم بالكالسيوم والبروتين.

الزيوت والدهون (استخدمها بكميات محدودة)

استخدمي أنواع الزيوت الغير مشبعة في الطبخ مثل زيت الزيتون وزيت بذور اللفت و زيت دوار الشمس. استخدمها بكميات قليلة . لا ننصح بالزبدة لأنها تحتوي على دهون مشبعة بكمية كبيرة. هذه الاغذية يمكنها حماية القلب والمحافظة على مستويات الكولسترول من الارتفاع. يفضل تناول الأطعمة الغنية بالدهون والسكريات وقت المناسبات فقط ولا تكون أكثر من حصه واحده في اليوم.

ما هي الوجبة الخفيفة الصحية؟

الكعك، الفشار السادة، حفنة من العنب أو قطعة فواكه، أصابع الخضروات، أعواد الخبز المحمصة مع الجبن أو الحمص للتغميس. جميعها سريعة التحضير و مغذية.

تذكري عزيزتي الأم

انه يتم بناء و تكوين العادات الغذائية في السنوات الاولى من العمر، هذا هو الوقت المناسب لتشجيع الأطفال للاستمتاع بخيارات الأطعمة الواسعة.

صفحة النشاط

• معوقات للأكل الصحي

هل تتذكري الأهداف التي وضعتها الأسبوع الماضي؟ راجعيهم وقيمي نفسك.

إذا كان هناك تقدم وإنجاز فهذا جيد وانتِ تستحقين مكافئة. إذا لم يكن هناك أي تقدم أو إنجاز ففكري بالعوائق المحتملة. هل كان طموحها عالي جدًا أم كان هناك افتقار للتحفيز؟

1.
2.
3.

الآن كيف يمكنكِ تعديل تلك الأهداف لتصبح أكثر قابلية للتحقيق؟

1.
2.
3.

الكربوهيدرات والألياف



الكربوهيدرات هي المصدر الرئيسي للطاقة. هناك نوعان منها:

النوع الأول: كربوهيدرات نشوية مثل البطاطس، الأرز، المعكرونة و الخبز.

النوع الثاني: كربوهيدرات سكرية مثل الحلويات، الكعك والبسكويت.

كثيراً من الناس يعتقدون بأن الكربوهيدرات النشوية تسبب السمنة، ولكنها تحتوي على نصف كمية السعرات الحرارية الموجودة في الدهون. المهم فقط هو مراقبة حجم الحصص المتناولة وتجنب اضافة الكثير من الدهون (الزيت، الزبدة، السمن) أو الملح في الطبخ. هكذا يمكن للكربوهيدرات أن تكون جزء رئيسي من النظام الغذائي الصحي.

الأطعمة النشوية

هذه تتضمن الخبز، حبوب الإفطار، المعكرونة، الأرز والبطاطس. حاولي التنوع بين خيارات القمح الكامل اذا امكن. فالقمح الكامل هو أفضل خيار. و لا تعطي النخالة النيئة للأطفال الصغار لأنها تملئ معدتهم.

الأطعمة السكرية

سكر المائدة، العسل، المربي، الشوكولا، البسكويت، الحلويات. الأطعمة والمشروبات السكرية يجب تناولها بكميات قليلة لأنها من الممكن أن تدمر صحة الانسان وتقلل شهيته للأطعمة الغنية بالعناصر الغذائية وتجعلهم غير قادرين على تناول وجباتهم الصحية .

ماذا عن الفاكهة؟

الفواكه تحتوي على السكريات ولكنها ايضًا تحتوي على الألياف، الفيتامينات والمعادن التي نحتاجها بشكل يومي. من الأفضل لك أنت وطفلك أن تسعى لتناول 2-3 حصص من الفاكهة كل يوم. وواحدة فقط من هذه الحصص تكون عصيرًا.

ما هو شكل الحصة الواحدة من الكربوهيدرات

الحصة التقريبية لعمر 1-6 سنوات

- ما بين نصف شريحة الى شريحة متوسطة من الخبز
- 4-8 رقائق سميكة من الشيبس مرة في الاسبوع
- 3-6 ملاعق طعام ممتلئة من حبوب الافطار
- نصف قطعة من الكعك او الفطير الصغير
- 75-150 مل من العصير الطبيعي 100% (مخفف جزء واحد من العصير في 10 اجزاء من الماء)
- ما بين نصف حبة الى حبة كاملة من البطاطس متوسطة الحجم
- 2-5 ملاعق طعام من المعكرونة أو الأرز

ملاحظة: كوني حذرة من كمية الدهون اذا تم اضافتها إلى هذه الأطعمة

الألياف

الألياف جزء مهم جدًا من النظام الغذائي الصحي. توجد في المأكولات النباتية وهي أيضًا تعرف بـ(النخالة). الألياف تمتص الماء مثل الاسفنج، لذلك عند تناولها تساعدك في الشعور بالشبع. ويمكنها ايضًا مساعدتك في تحريك وتمرير الطعام خلال جهازك الهضمي. ولكن هي بحد ذاتها لا يمكن أن تُمتص، لذلك يمكنها معالجة حالات الإمساك.

طرق لإضافة الألياف في الطعام:

- استبدال الخبز الأبيض بالخبز البر (الدقيق الاسمر\الحبوب الكاملة)
- استبدال المعكرونة البيضاء بالمعكرونة السمراء
- اختيار حبوب الافطار بالقمح الكامل مثل الشوفان و الثريد
- تناول الفاصولياء والعدس بشكل أكبر و إضافتها مع اللحوم في الطهي
- تناول قشور البطاطس
- تناول 5 حصص من الفواكه والخضروات كل يوم

يمكن للأطفال تحمل كمية صغيرة من الألياف في الوجبة الواحدة لأنها تملئ المعدة ومن الممكن أن لا يكون لديهم شهية للوجبة القادمة. اذا كنت تريدين زيادة كمية الألياف في طعام ابنك، فقمي بعمل التغييرات ببطء وقدمي له الكثير من الماء ليساعد في امتصاصه.

صفحة النشاط

قياس الايجابيات والسلبيات

في الأسابيع السابقة تحدثنا عن تحقيق الأهداف عن طريق:

- وضع خطة ذكية (محددة، قابلة للقياس، قابلة للتحقيق، ذات صلة، محددة الوقت)
- التعرف على العوائق المحتملة وإيجاد الحلول المعقولة لها.

في هذا الأسبوع نود تزويدهم بتكنيكيات أكثر لتأكد أنك تتخذين القرار السليم.

صنّفي ايجابيات وسلبيات أهدافك. إذا كانت الايجابيات أكثر من السلبيات، سيكون تحقيق هدفك أكثر سهولة. هنا مثال لتشجيعك:

الهدف: أخذ الاطفال للسباحة مساء كل سبت

الفوائد من محاولة تحقيق الهدف أو تحقيقه سلبيات محاولة تحقيق الهدف

• سأضطر لإتاحة الوقت لأنشطة مثل هذه كل أسبوع • بعض الانشطة ممكن ان تكون مكلفة • بعض الانشطة تكون صعبة في البدايات	• الأطفال سيتعلمون السباحة • سأصبح رشيقة • سأشعر بحالة أفضل • سأكون قدوة جيدة لأطفالي • مقاسات ملابسي ستناسبني أكثر • الحصول على مزيدًا من الطاقة

الفواكه والخضروات



تحتوي الفواكه والخضروات على الالياف ومجموعة متنوعة من الفيتامينات والمعادن والتي نحتاجها لوظائف مختلفة في الجسم. أهم هذه الوظائف التي تفاعلها هذه العناصر الغذائية هو حماية الجسم من الامراض وأهميتها لنمو الجسم. أيضاً نحتاجها لصحة العظام، الاسنان، اللثة، الجلد، الاظافر والدم.

ما هي كمية الخضروات والفواكه التي يجب علينا تناولها كل يوم ؟

نحتاج أن نتناول على الأقل 5 حصص متنوعة من الخضروات والفواكه يوميا. بطريقة أخرى نحتاج أن نأكل ألوان الطيف (لَوْن أَكَلِكْ). عن طريق تناول ألوان مختلفة من الخضروات والفواكه كل يوم بذلك نتأكد من حصولنا على جميع الفيتامينات والمعادن التي يحتاجها جسمنا لكي يبقى سليماً وقوياً. الخضروات والفواكه قليلة السعرات الحرارية والدهون وعالية بالألياف لذلك هي اطعمة ممتازة لبقاء الوزن صحي .

ما هو شكل الحصة الواحدة من الخضروات والفواكه؟

كقاعدة رئيسية، الحصة الواحدة تعادل كف اليد الواحدة ممتلئة. ذلك يعني أن البالغين سيكون لهم حصة أكبر من الأطفال.

هنا أحجام تقريبية للحصة الواحدة للأطفال من عمر سنة إلى 5 سنوات :

- 1\2 حبة موز أو
- 1 تفاحة أو برتقال أو كيوي أو كمثرى
- 6-10 حبات من العنب (تأكدي من تقطيعها إلى أحجام صغيرة للأطفال تحت عمر الـ 5 سنوات)
- 1-3 ملاعق خضار
- 75-150 مل عصير طازج 100% (مخفف 1 جزء من العصير الى 10 اجزاء من الماء)

تمتعي بأنواع متعددة من الخضروات والفواكه مع كل وجبة !

مثال ليوم واحد فيه 5 حصص :

- وجبة الافطار: حبوب الافطار مع ملعقة واحدة من الزبيب والحليب
- وجبة خفيفة: كمثرى
- وجبة الغداء: سلطة تونة مضاف اليها بطاطس، لبن زبادي
- وجبة خفيفة: كعك غير محلى
- العشاء: معكرونة معدة في المنزل مع صوص الطماطم، يوسفى

اتمنا الـ 5 حصص! يمكنك الحصول على المزيد بشرب 150 مل من العصير الطبيعي 100% (مخفف 1:10) مع وجبة الافطار أيضا يمكنك استبدال الكعك بالموز أو اصابع الجزر

ما أنواع الفواكه والخضروات التي تحتسب؟

جميع الخضروات والفواكه سواء كانت طازجة، مبردة، مجففة، مجمدة، معلبة (في عصير طبيعي وليس شراب مركز)، عصير طبيعي 100% أو عصائر الكوكتيل.

صفحة النشاط

مكافآت غير الأكل

إذا كنتي تشجعين طفلك على التصرف الجيد أو أن ينتبه إلى شيء جيد قد فعله كيف تفعلين ذلك غالبًا ؟ هل تحتضنيه أم تكافئيه بقطعة شوكولا ؟

من الأفضل لصحتك وصحة طفلك في المستقبل، أن تعطيه بعضًا من الوقت لكي تشاركه العاطفة والوجدان. هذا ليس فقط لأن كلاكما ستستمتعان بهذا ولكن استخدام الأكل كمكافئة يمكن أن يولد علاقة عاطفية مع الأكل ويبدأ بالأكل حتى بدون الشعور بالجوع.

ليس من الضروري أن تكون المكافئة مكلفة. على العكس تمامًا، أفضل المكافآت تكون مجانية. أفضل الأمثلة: القراءة، الاستماع للقصص، الذهاب في رحلة للتنزه وركوب الأرجوحة. أو حتى استخدام لوحة المكافآت وتضعي عليها الملصقات.

فكري في مكافآت تريدين اعطاها لطفلك، املئي لوحة المكافآت لهذا الاسبوع وترقيي اذا يمكن لطفلك أن يأكل 5 حصص من الفواكه والخضروات لمدة اسبوع واحد.

لوحة مكافئاتي

سمي :

	الأحد
	الاثنين
	الثلاثاء
	الأربعاء
	الخميس
	الجمعة
	السبت

إذا كنت بطلاً مكافئتي ستكون

منتجات الألبان ، الكالسيوم و فيتامين د



الحليب ومنتجات الألبان هي واحدة من الاربع المجاميع الرئيسية التي تزودنا بالكالسيوم لقوة العظام والاسنان. الاطفال في مرحلة الروضة يحتاجون 3 حصص يومياً من منتجات الألبان لتتأكد أنهم حصلوا على كفايتهم من الكالسيوم من أجل قوة عظامهم وعدة وظائف أخرى لأعضاء الجسم، إيجاد وقت يومياً لعمل التمارين الرياضية، الرقص واللعب يمكن أيضاً أن يساعد في تقوية عظامهم. إذا كانت العظام قوية يمكننا تقليل احتمالية حدوث الكسور والاصابة بهشاشة العظام عند الكبر.

مصدر الكالسيوم من منتجات الألبان تشمل:

الحليب، اللبن، الأجبان، الجبن الأبيض

مصادر أخرى للكالسيوم غير منتجات الألبان تشمل:

سمك ذات العظام اللين\الخفيف (سمك الرنكة، الساردين)، الخضروات الورقية الخضراء، الخبز الأبيض، حبوب الافطار المدعمة، البقوليات (الفاصولياء، العدس)، المكسرات (اللوز، الجوز، البندق)، السمسم، الفواكه المجففة، التوفو، مشروبات و أطعمة الصويا المدعمة بالكالسيوم(مثال: حليب الصويا).

من المهم الانتباه على الاطفال عند تناول المكسرات والاسماك ذات العظام الخفيفة حتى لا يختنقوا!

نحتاج فيتامين د لتقوية عظامنا من أجل ..

فيتامين د يساعدنا على امتصاص الكالسيوم من الطعام، نحصل على فيتامين د عند تعرضنا لأشعة الشمس في فصل الصيف. النساء الحوامل والمرضعات والأطفال تحت سن الـ 5 يحتاجون فيتامين د أكثر من الشخص العادي. الأطعمة الغنية بفيتامين د تشمل: الاسماك الدهنية، البيض، السمن المدعم وحبوب الافطار المدعمة.

للحصول على عظام قوية استمر في الحركة:

في كل يوم يجب على الأطفال في مرحلة الروضة أن يكونوا نشيطين باللعب والحركة لمدة 3 ساعات للحفاظ على صحة قلوبهم والأوعية الدموية وبناء عظام قوية.

مثال وجبات ليوم واحد:

- حبوب الافطار مع الحليب او فتة الخبز بالحليب - كأس من عصير الفاكهة مدعم بفيتامين د	• الفطور:
- ساردين أو فاصولياء مطبوخة مع توست أبيض - خضار مطبوخة مع التفو و خضار ورقية خضراء - أومليت مع الجبن - سمك مع الصوص الأبيض	- الغداء أو العشاء:
- مهلبية الحليب مثل الساقودانة او الحليب بالارز - لبن زبادي	- للحلى:
- فواكه مجففة - بسكويت مع الجبن - حليب دافئ	- وجبة خفيفة:

ما هو شكل الحصصة الواحدة من الكالسيوم:

الحجم التقريبي لطفل من عمر سنة إلى 5 سنوات:

- 1½ كأس صغير من الحليب (100-120) مل
- 1 وعاء متوسط الحجم من اللبن (125-150) مل
- مثلث واحد من الجبن (15-20) جم

هذه الحصص تزود الطفل في مرحلة الروضة بالكمية الكافية من الكالسيوم كل يوم. يمكنك التنويع ما بين أنواع الحصص أو الاكتفاء بنوع واحد لأخذ احتياج الكالسيوم كاملاً منه ليوم واحد.

مثال اذا اعطيتي طفلك 3 كاسات من الحليب (لأن الطفل يحتاج 3 حصص من منتجات الألبان في اليوم الواحد) فذلك يعني أنه سيستغني عن الجبن واللبن. منظمة الصحة العالمية توصي بتناول الحليب قليل الدسم للأطفال بعد سن الثانية من العمر.

صفحة النشاط

التربية الفعّالة

نحن نعلم أن العادات الغذائية تختلف من طفل إلى آخر حتى ما بين الاخوة ويعود ذلك إلى سلوكياتهم عند الأكل وشخصيات كل فرد منهم. اذا كان أحد أطفالك لا يأكل كفايته من الطعام أو لا يأكل أنواع متعددة من الاطعمة، فتجدين نفسك تجبرينه على الأكل. واذا كان لديك طفل شهيته كبيرة للأكل، تجدين نفسك تحاولين تقليل كميات اكله أو منعه من بعض أنواع الاطعمة في كل الأحوال من الممكن أن لا تصلي إلى النتيجة التي ترغبين بها. ومن التي يتناولها. المحتمل أن يولّد ذلك لطفلك الذي منعتي عنه بعض الاطعمة شهيه أكبر لها وينفر من الطعام الذي تجبرينه عليه.

أذا ما هي أفضل طريقة لتشجيع طفلك لجعله يختار أفضل الخيارات من الأطعمة الصحية؟

الاسلوب الفعّال للتربية هو أفضل طريقة لتحسين سلوكيات وعادات طفلك عند الأكل . أهم 3 محاور في الاسلوب الفعّال هو: 1- الحماس 2- التحكم 3- البناء

هنالك دراسة جميلة قارنت بين طلاب الجامعة الذين تمت تربيتهم بحيث يتم جعل قرار الطفل متمركز لديه شخصيا و بين طلاب الجامعة الذين تمت تربيتهم بحيث ان مركزية القرار لدى الوالدين و ليس الطفل. و كانت النتيجة ان الأطفال الذين تمت تربيتهم بحيث تكون مركزية القرار لديهم اصبحوا يختارون اطعمة صحية اكثر اثناء بلوغهم بينما الأطفال الذين تمت تربيتهم بحيث تكون مركزية القرار لدى والديهم اصبحوا يقومون باختيارات غير صحية عندما كبروا..

نستنتج من ذلك انه من المهم جدا مساعدة الطفل على اتخاذ القرار و من الذكاء ان يتم توجيهه لاتخاذ القرار السليم بشكل غير مباشر و اليك عدة طرق تساعدك على تشجيع طفلك لاختيار خيارات أكثر صحة مثل :

- تزويد طفلك بعدة خيارات مناسبة وجعله يختار أيهما يفضل
- تقديم الطعام بشكل جذاب ومغري
- حبّبي طفلك في الأكل الصحي

البروتين والحديد



اللحوم، الأسماك والبدائل النباتية جميعها تزودنا بالبروتين من أجل صحة ونمو أجسادنا. وأيضاً تزودنا بالحديد لمساعدة جسمنا في نقل الاوكسجين حول الجسم. هذه المجموعة الغذائية صحية وقليلة الدهون طالما انك تختارين قطع اللحم قليلة الدهون. تجنبي الأطعمة المقلية واستخدمي طرق الطبخ الصحية مثل الشواء، الخبز، البخار و المايكروويف.

أي الأطعمة تعتبر من هذه المجموعة ؟

اللحوم البيضاء والحمراء، الاسماك الدهنية، البيض، البقوليات، التوفو، مفروم الصويا، المكسرات والبذور جميعها مصادر غنية بالبروتين.

ما هو شكل الحصة الواحدة من البروتين ؟

الحجم التقليدي للحصة هو حجم باطن كف اليد (مثال: حجم باطن كف يد طفلك هو حجم حصته من البروتين وحجم باطن كف يدك هو حجم الحصة التي تحتاجينها من البروتين).

هنا احجام تقريبية للحصة الواحدة للأطفال:

- بيضه واحدة
- 1-2 اصابع السمك
- 2-3 ملاعق فاصولياء مطبوخة
- 1 1/2-2 ملاعق لحم، سمك، بقوليات
- 1-2 ملاعق مكسرات مقطعة (الا اذا كان الطفل لديه حساسية من المكسرات)

الأكل المناسب لصحة قلبك

الاسماك الدهنية (الساردين، الماكريل، السالمون، التونه، الرنكة) مفيدة جداً للقلب لاحتوائها العالي من الأوميغا-3. قدّمي السمك كوجبة مرة في الاسبوع.

طرق صحية لاختيار البروتين

- اختاري القطع الخفيفة (قليلة الدهون)
- ازالة الجلد والدهون الظاهرة
- تجنبى اضافة الملح أثناء الطبخ
- استخدام الاعشاب والبهارات المعتدلة من أجل النكهة
- استخدام البقوليات والفاصولياء لزيادة القيمة الغذائية للوجبة
- ازالة الدهون الظاهرة على السطح عند الطبخ مثل الإيدام
- صفّي الملح والماء والزيت من المعلبات قبل التقديم

صفحة النشاط

كوني أنتِ القدوة

في الكثير من الاحيان تلاحظين أن طفلك يقلدك في اختياراتك للأكل في ما تحببه وما لا تحببه من الأطعمة. هذا هو الوقت المناسب لتكوني مثال جيد يقتدي فيه أطفالك .

هناك طريقتين رئيسيتين لتكوني قدوة:

- 1- بالكلمات: مثل أن تقولي بصوت عالي ما تحببه من الأكل بطريقة مباشرة. يجب أن يكون لديك نظرة ايجابية وتقبل للأكل الصحي.
جعل أوقات الوجبة لطيفة ومرحة يصنع أفضل الفرص للوالدين بالتحدث عن القيمة والفائدة الغذائية لبعض الأطعمة لرفع مستوى وعي الأطفال وتشجيعهم دائماً لجعل خبراتهم في الأكل دائماً أفضل.
- 2- بالأفعال: عن طريق تناول مأكولات معينة أمام أطفالك واستخدام تعابير الوجه تدل على أنك أحببت بعضاً من الأطعمة. إذا كنت تريدين تشجيع أطفالك على تناول أطعمة لا يحبونها الطريقة الفعالة هيا أنك تُريهم صور لأشخاص يتناولون ذلك الطعام مع تعابير وجه مستمتعة أثناء الأكل. هذا يمكن أن يرفع رغبة طفلك لتناول ذلك الطعام الذي لا يحبه.

انتبهي !

من المهم جداً ان تنتبهي أنه من الممكن أن تكوني قدوة لهم من غير قصد. فتفضيلات الأكل عند الوالدين يمكنها أن تنعكس على اختيارات أطفالهم للأكل.
هل يمكنك التفكير ببعض العادات الغذائية التي تريدين لطفلك أن يتبناها:

..... -
..... -
..... -

هل يمكنك التفكير ببعض العادات الغذائية التي تريدين من طفلك التوقف عنها ؟

..... -
..... -
..... -

الدهون



الدهون تزود أجسامنا بالطاقة وتمدها أيضا بالأحماض الدهنية الأساسية ، والتي لا يستطيع الجسم أن يصنعها. كما تساعد الدهون على امتصاص الفيتامينات أ ، د و ك .

جميع أنواع الدهون عالية في الطاقة ولديها ضعف السرعات الحرارية التي في البروتين أو الكربوهيدرات

نحن جميعًا بحاجة إلى بعض الدهون في النظام الغذائي للطاقة والنمو . فإذا كان هناك الكثير من الدهون في النظام الغذائي سيتم تخزين الدهون التي لا يتم حرقها. و ترتبط العديد من الحالات الصحية مثل البدانة وأمراض القلب والسكري بزيادة الدهون في الجسم

أنواع الدهون

مصادر الدهون قد تكون حيوانية أو نباتية (دهون مشبعة و دهون غير مشبعة).

الدهون المشبعة

توجد الدهون المشبعة بشكل رئيسي في المنتجات الحيوانية وجوز الهند وزيت النخيل والأطعمة المصنعة. هذه الدهون يمكن أن تزيد من كمية الكوليسترول الضار في الدم LDL ، والتي يمكن أن تزيد من خطر الإصابة بأمراض القلب والسكتة الدماغية

الدهون غير المشبعة

غالبًا ما تسمى الدهون غير المشبعة بالدهون "الجيدة". وهي عكس الدهون المشبعة لأنها يمكن أن تساعد في خفض نسبة الكوليسترول في الدم. و توجد الدهون غير المشبعة المتعددة والأحادية في الزيوت من الأسماك والمكسرات والبذور والنباتات

الدهون غير المشبعة	الدهون المشبعة
(أستبدل بهذه)	تناول القليل من هذه الأطعمة
سمن	زبدة ، شحم الخنزير
افوكادو	كريمة ، مايونيز
زيت الزيتون وزيت اللفت	الجبن الجامد
السكك الدهني واللحوم الخالية من الدهن	لحم الخنزير المقدد ، النقانق
المكسرات	المعجنات ، البسكويت ، الكعك

اوميغا 3 هي دهون متعددة غير مشبعة موجودة في الأسماك الدهنية.

ولها مصادر أخرى تشمل بعض الزيوت النباتية مثل: الجوز واللوز وبذور اليقطين. وهي ضرورية للتطور الصحي للدماغ والعينين والجهاز العصبي

الدهون المتحولة (المهدرجة)

توجد الدهون المتحولة بكميات صغيرة في اللحوم. و تعتبر الزيوت النباتية المتحولة مصدرًا رئيسيًا ، ولكن بعض الشركات أزالّت هذه العناصر من منتجاتها التجارية. لذا ، من المهم التحقق من الملصق الغذائي لمعرفة ما إذا كان المنتج يحتوي على دهون متحولة أم لا، كما يمكن أن تؤدي الدهون المتحولة إلى رفع مستويات الكوليسترول في الدم . لذلك أنت تحتاج إلى التركيز على تقليل كمية الدهون المشبعة والدهون المتحولة من نظامك الغذائي .

ملاحظة : الزيوت المهدرجة المقصودة ليست زيت الذرة ودوار الشمس وغيرها من الزيوت النباتية العادية لكن المقصود بالمهدرجة هو السمن النباتي أو:زيت مهدرج(وهو زيت تم غليه لعدة ساعات مع اضافة هيدروجين ليتصلب ويصبح صلب مثل الفازلين ولكنه بطعم ورائحة السمن ومثاله تنكة ابوشوكتين وملعقتين وغيرها ومن استخدامات السمن النباتي الفرموزا الفطائر الهشة فطير المشلتلت الكروسان البراتا تيميس بالمسن تيميس البسكوت البقلاوة السمبوسة الرقاق بعض انواع القشطة المصنعة (وهي مخصصة للحشو والخبز) الفطير

تذكري! أنه بغض النظر عن نوع الدهون إلا أن جميع الدهون تحتوي على نفس الكمية من الطاقة أو السعرات الحرارية ، لذلك يجب تناول الأطعمة مثل زيت الزيتون والمكسرات بكميات صغيرة .

صفحة النشاط

مساعدة الأطفال على اتخاذ خيارات صحية في المنزل

إعادة ترتيب البيئة المنزلية

في بعض الأحيان يساعد الأطفال أنفسهم على تناول الكثير من الحلويات والعصائر والأصناف الغير صحية. هنا ، قد يشعر بعض الأهل أنهم يفقدون السيطرة على أطفالهم. وحتى عندما يحاولون مناقشة هذه المسألة مع أطفالهم ، يعتقدون أن لا شيء يمكن أن يغير اقتناع الطفل

في مثل هذه الحالات ، فإن الطريقة الأمثل هي تغيير الأشياء في المنزل عن طريق:

- حفظ الأطعمة العالية في الدهون والسكريات بعيداً عن الأنظار.
- جعل الأطعمة الصحية متاحة وسهلة الوصول إليها.
- إعداد طبق من الفواكه والخضروات المتنوعة ووضعها بالقرب من الأطفال.
- وضع الأطعمة التي تريد أن يتناولها أطفالك في الجزء السفلي من الثلاجة ، ذلك يساعدكم على أكله.

تذكري!

أن مساعدة الأطفال على اتخاذ خيارات صحية في المنزل يتضمن جعل الطعام الصحي متاح و سهل الحصول عليه في المنزل و استخدام طرق غير مباشرة لتشجيع الطفل على اتخاذ خيارات صحية أكثر ، يمكن أن يؤدي ذلك إلى استهلاك غذاء صحي من قبل الطفل

السكريات



سابقًا علمنا عن نوعين مختلفين من الكربوهيدرات، وهي: السكريات والنشويات.

نحن نعلم أن الأطعمة التي تحتوي على السكريات البسيطة (مثل المشروبات الغازية والشوكولاتة والبسكويت والحلويات) تكون ضارة بأسناننا.

فالأطعمة السكرية تحتوي على الكثير من الطاقة ولكن القليل من الفيتامينات أو المعادن ، ولهذا السبب نسمي هذا النوع من الأطعمة "بالسعرات الحرارية الفارغة".

السكر:

السكر موجود في العديد من الأشكال المختلفة ويمد جسمنا بالطاقة. و جميع أنواع السكر المختلفة لها طعم حلو وأبسطها هو الجلوكوز. وتشمل السكريات الطبيعية : العسل، والفركتوز الموجود أساسًا في الفاكهة، واللاكتوز الموجود في الحليب. وتشمل الأشكال الأخرى مثل: السكر (سكر المائدة) ، والدكستروز ، المالتوز ، النشا المحلل ، و العسل الأسود أو دبس .

تضاف السكريات إلى العديد من الأطعمة التجارية وتوفر السعرات الحرارية الفارغة فقط. لذلك يجب أن تؤكل هذه الأطعمة بكميات صغيرة .

هل السكر سيء بالنسبة لك؟

ليس بالضرورة. إنه بمقدار ما نأكله وكم مرة يحدد ما إذا كان سيئاً بالنسبة لنا.

تناول الكثير من السكر ، وخاصة الأطعمة والمشروبات مع السكريات المضافة ، يمكن أن تسبب تسوس الأسنان ويؤدي إلى مشاكل في الوزن. كما أن النظام الغذائي الذي يحتوي على نسبة عالية من السكر يكون أقل احتمالاً للتوازن الجيد المطلوب في الوجبة وقد يكون منخفضاً في البروتين والفيتامينات والمعادن والألياف. فمن الأفضل لأسنانك إما تجنب الأطعمة والمشروبات السكرية أو تناولها في أوقات الوجبات فقط .

جرب هذه البدائل

أطعمة سكرية

حبوب الإفطار المغلفة بالسكر	الحبوب الكاملة أو عصيدة الشوفان
الحلويات والبسكويت والكعك	الفواكه الطازجة أو المجففة ، رغيف الشعير ، كعكة الفاكهة والمكسرات والبذور
الحلويات الحلوة	تفاح مخبوز ، زبادي ، بودنج الأرز
فواكه معلبة (في شراب)	فواكه معلبة (في عصير)
مشروبات سكرية	عصير نقي مخفف بالماء، والحليب وعصائر الفاكهة والماء
مرابي	مرابي قليل السكر ، جبنة خفيفة مع شرائح من الموز أو التوت
الخبز المنزلي	حاول خفض نسبة السكر المذكورة في الوصفة
السكر في المشروبات	قم بتخفيض السكر تدريجياً ، ثم اقطعه

ما الذي تنظر إليه على الملصق الغذائي؟

• عند قراءة ملصقات الطعام ، من الأفضل أن تحاول تجنب الأطعمة إذا كان السكر هو المكون الأول في القائمة (ما لم يتم تناوله بكميات صغيرة ، مثلاً ، المرب).

• إذا كان الطعام يحتوي على نسبة عالية من الكربوهيدرات ، نحس من حمية السكريات الموجودة تحت قسم "السكريات" في الملصق.

انظر أدناه على سبيل المثال.

جميع الكربوهيدرات في هذا الطعام هو سكر!

NUTRITIONAL INFORMATION	Per can 240ml لكل عبوة	المعلومات الغذائية	% GDA*
Energy (kcal)	99	طاقة (كيلو كالوري)	5
Protein (g)	2.4	بروتين (غ)	5
Carbohydrates (g)	18.0	كربوهيدرات (غ)	7
of which sugars (g)	13.7	منها سكر (غ)	15
Fat (g)	1.9	دسم (غ)	3
of which saturates (g)	1.4	منها مشبع (غ)	7
Sodium (mg)	91	صوديوم (غ)	4

*Guideline Daily Amounts of an average adult (2000 kcal). Pack contains 1 portion. Portions should be adjusted for children of different ages.
*إرشادات الاستهلاك اليومي للشخص البالغ يبلغ (2000 كيلو كالوري). تحتوي كل عبوة على 1 حصة. يجب تعديل الحصص للأطفال وفقاً لمختلف الأعمار.

صفحة النشاط

الأكل الانتقائي :

الأكل الانتقائي قد يكون مصدر قلق للوالدين. والخبر السار هو أنه غالبًا ما يكون طبيعيًا تمامًا ، وهو أحد الطرق التي يُظهر بها أطفالك أنهم أصبحوا أكثر استقلالاً. يبدأ الأكل الانتقائي غالبًا في نهاية العام الأول عندما يتوقف الأطفال عن النمو بسرعة كبيرة ، وتقل شهيتهم بشكل طبيعي قليلاً. إذا لم يفقد طفلك وزنه أو أصبح مريضًا بسبب الأكل الانتقائي ، حاول ألا تقلق

فيما يلي بعض التلميحات للمساعدة في التحكم بالبدع الغذائية للطفل :

- حافظ على الروتين من ثلاث وجبات مع وجبات خفيفة بينها .
- تجنب السماح لطفلك "باختيار" الطعام .
- تقديم أطعمة بسيطة وصحية .
- قم بعرض كميات صغيرة للطفل وامدح طفلك إذا تناول طعامه .
- قم بتحويل الوجبات إلى مناسبة اجتماعية من خلال تناول الطعام مع طفلك.
- إن تجربة الطعام أمام طفلك قد يجعله يشعر بمزيد من الثقة في تجربته.
- شجع طفلك على التعامل مع الوجبات و إطعام نفسه.
- إذا كانت الأطعمة الجديدة مشكلة ، فالكمية البسيطة منها هو جهد جيد. قد يحتاج الأطفال التأمل في الطعام ولمسه أو مشاهدة الآخرين يأكلونه قبل تجربته. استمر في المحاولة؛ قد يستغرق عدة محاولات (5-15 مرات) قبل قبول الطعام!
- لا تقم إطلاقاً بفرض الطعام على الطفل بالقوة - فهذا يمكن أن يضع الطفل تحت ضغط وتوتر أثناء تناول الطعام .
- امنح طفلك متسعاً من الوقت لتناول الطعام ، ولكن حدد مهلة زمنية تتراوح بين 20-30 دقيقة وانهي الوجبة حتى إذا كان الطعام لا يزال غير مأكول في ذلك الوقت.

كميات الطعام



نتحدث هنا عن الأطباق التي تشغل حيزاً كبيراً على الطاولة ، وقطع الكوكيز العملاقة ، وألواح شوكولاتة كبيرة تصل لحجم المسطرة. نعم! لقد زاد حجم طعامنا منذ السبعينيات ، خاصة عند تناول الطعام في المطاعم والمقاهي. غالباً ما تباع لنا الشركات التي تصنع هذه الأغذية الباهظة الثمن ، لذلك نحن كمستهلكين ، يجب أن نكون أصحاب إرادة قوية وأن نكون قادرين على اتخاذ خيارات مستنيرة.

ما المشكلة في الكميات كبيرة الحجم ؟

- (1) - عندما نستمر في المشاهدة ، ونقوم بأكل أجزاء كبيرة دون أن نشعر ، فإن الحجم يصبح طبيعياً ، وبالتالي يمكن أن يصبح ما نفكر فيه كمتوسط حجم الوجبة مشوهاً.
- (2) - العديد منا نشأ وهو مطالب "بإنهاء ما هو موجود على الطبق". فعندما نواجه جزء كبير من الطعام ، قد نستمر في الأكل حتى عندما لا نكون جائعين.
- (3) - الأشخاص الذين يتناولون كميات أكبر لا يعوضون ذلك بتناول وجبات صغيرة لاحقاً وبذلك يأكلوا سعرات حرارية أكبر بشكل عام.
- (4) - كثيراً ما نأكل كميات أكبر من الموصى بها على الملصق الغذائي.

ما الخطب مع كميات الطعام في يومنا هذا ؟

•ازداد حجم الكميات التي توفرها المطاعم و بالنتيجة هي تناول جزء أكبر يعني أننا نستهلك مزيداً من السعرات الحرارية (الطاقة) ، وكثيراً ما تكون من الدهون والسكر والملح. وهذا هو أحد الأسباب العديدة التي تجعلنا نشاهد المزيد من البالغين والأطفال الذين يعانون من زيادة الوزن.

ما الذي يمكن أن نفعله حيال كميات الطعام الضخمة ؟

- إزالة الأواني الكبيرة والحزم الغذائية من منازلنا واستخدام أطباق أصغر بدلاً من ذلك .
- شراء الغذاء في حزم صغيرة أو تقسيم الحزم الكبيرة إلى أجزاء أصغر.
- إحضار وجبات الغذاء المعدة في المنزل إلى العمل .
- شارك بعض الكميات الخاصة بك إذا كنت تتناول الطعام في الخارج.
- ابدأ بتناول السلطة املاً طبقك بالكثير من الخضراوات بحيث يكون هناك مساحة أقل للأطعمة الأخرى الغنية بالسعرات الحرارية والدهون!

صفحة النشاط

تخطيط قائمة الطعام

الآن وقد تحدثنا عن جميع المجموعات الغذائية الخمس (الفواكه والخضروات ، الكربوهيدرات والبروتينات ومنتجات الألبان والزيوت)

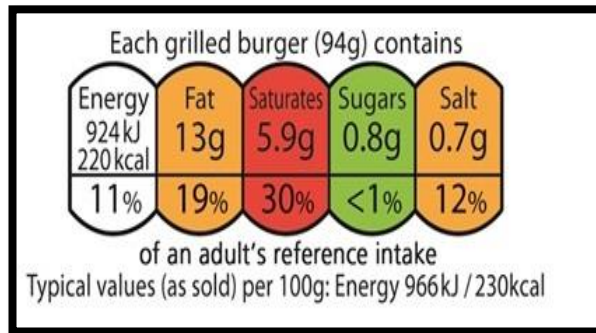
وتحدثنا عن كيفية إدارة كميات الطعام ، هنا يوجد تحدي لك! بالتفكير للغد أو لليوم التالي ، لماذا لا تعمل على ما ستأكله أنت وعائلتك ، مع التأكد من حصولك الكميات الصحيحة من كل مجموعة غذائية؟

في ما يلي أمثلة لأطعمة يتناولها شخص ما في اليوم لشخص بالغ ، يمكنك استخدام هذا كمثال لمساعدتك في تخطيط يومك وتخطيط قائمة الطعام لطفلك

الطعام	لخضروات والفواكه (5)	الكربوهيدرات (3)	البروتين (2-3)	الألبان (3)
زبدية عصيدة مع الحليب كوب من الشاي مع حليب وسكر موزة في منتصف النهار سلطة + تونة وذرة ساندوتش توت مضاف لزبادي قليل الدسم بانكيك بعد الظهر الدجاج مع الخضار والمعكرونة Rhubarb crumble and custard ماء والكوسا الخالية من السكر للشرب خلال اليوم المجموع				

ملصقات الطعام

(معلومات القيمة الغذائية للمنتج)



يمكن أن تكون ملصقات الطعام مفيدة جدًا في مساعدتنا على اختيار الأطعمة الصحية ، حيث يمكننا استخدامها للتحكم في تناول الأطعمة التي تحتوي على نسبة عالية من الدهون والسكريات والأملاح. ربما لاحظت أيضًا أن هناك طرقًا مختلفة لعرض المعلومات الغذائية على العبوات الغذائية مثل نظام إشارات المرور والكميات المسموحة يوميًا. في لحظة ، يمكنها إخبارنا ما إذا كان الطعام صحيًا أو غير صحي.

ما هو نظام وضع إشارات المرور؟

تستخدم المنتجات الغذائية التي تحمل علامات إشارة المرور على واجهة المجموعة ألوانًا لتظهر لك ما إذا كان الطعام يحتوي على كميات كبيرة أو متوسطة أو منخفضة من الدهون و (الدهون المشبعة) والسكريات والملح. غالبًا ما تكون الأطعمة تحتوي على الألوان الثلاثة جميعها ، لذلك حاول تناول الأطعمة التي تحتوي على لون أخضر / أو أصفر أكثر من اللون الأحمر.

لون إشارة المرور	كمية الدهون ، الدهون المشبعة ، السكريات أو الملح لكل 100 غرام
الأحمر	عالية . تناول هذا الطعام بين الحين والآخر أو بكميات صغيرة
الأصفر	متوسطة. الأصفر هو أفضل من الأحمر ولكن الأخضر أفضل منه
الأخضر	منخفضة. اختيار صحي أكثر ، قم باختيار الكثير من هذه الأطعمة

ماهي مراجع الكميات اليومية أو GDAs ؟

تعتبر المراجع للمقدار المسموح في الأغذية (RI's) دليلاً للكمية الإجمالية للسعرات الحرارية والسكر والدهون و الملح للشخص الطبيعي البالغ ليوم واحد. بشكل عام ، يحتاج الرجال إلى حوالي 2500 كالوري في اليوم ، والنساء حوالي 2000 كالوري ،

و 15 الأطفال في عمر الخمس سنوات من العمر حوالي 1500 كالوري ، وفي سن الثالثة من العمر يحتاجون تقريباً 1300 كالوري ، اما في عمر سنة واحدة فيكفيهم حوالي 900 كيلو كالوري في اليوم.

يجدر تذكر:

GDAs تعتمد غالباً على شخص بالغ عادي من الوزن الطبيعي .

GDAs هي دليل وليس هدفاً، أي إذا كنت تأكل طعاماً يحتوي على 17% من كمية الدهون المسموحة لك من GDA ، فهذا لا يعني أنك بحاجة إلى تناول 83% المتبقية من GDA الدهون الخاصة بك في ذلك اليوم!

•يرجى أن تضع في اعتبارك أن معظم الملصقات الغذائية موجهة لمتطلبات البالغين.

الملصقات الغذائية باختصار

- لا يوجد نظام مثالي لوضع العلامات!
- استخدم حكمتك عند قراءة الملصقات !
- إذا كان الملصق يقول أن الطعام منخفض في الدهون ، تأكد من أنه لا يعوض ذلك عن طريق زيادة كمية السكر (وربما السعرات الحرارية).

صفحة النشاط

قم باختيار منتجات أقل في الدهون و السكر

هناك الكثير من منتجات السكر والدهون المتاحة ولكن كيف يمكنك معرفة الفرق بينهم ؟
استخدم هذا الجدول عند الخروج للتسوق في هذا الأسبوع للنظر في ما تشتريه لنفسك أو لعائلتك - ومعرفة ما إذا كان هناك خيار صحي يمكنك تجربته.

قليل الدسم	يحتوي على أقل من 3 غرام من الدهون لكل 100 جرام / 100 مل من الطعام أو الشراب ، على سبيل المثال ، الزبادي قليل الدسم.

دهون أقل من 5% أو 95% خالية من الدهون	يكون المنتج الغذائي يحتوي على أقل من 5 غم من الدهون لكل 100 غرام. ومع ذلك ، إذا قمت بشراء وجبة جاهزة وزنها 400 جرام ، فهذا يعني أنك تتناول 20 جم من الدهون! انظر إلى الكمية الإجمالية للدهون في كل وجبة وقارنها بالمراجع.

سكر غير مضاف	يعني - لم تتم إضافة السكريات - غالباً ما يكون هذا على عصائر الفواكه والقرع ولكن تذكر أنه تحتوي على السكريات الطبيعية بالفعل ومن الممكن أن تكون عالية.

سكر قليل	يحتوي على أقل من 5 غرام سكر لكل 100 جرام / 100 مل من الطعام أو الشراب ، على سبيل المثال ، جيلي منخفض السكر.

الأخطاء الشائعة والخرافات في الحميات



كل يوم نسمع قصة عن كيف فقدت إحدى المشاهير كمية كبيرة من الوزن عن طريق تناول طعام نادر و "سحري" لعدة أشهر أو من خلال اختبار شعرها أو لسانها أو أظافرها لإخبارها عن مدى صحتها !

في بعض الأحيان نشعر أن الطريقة الوحيدة لنا لنمط حياة صحي هي إنفاق الكثير من المال على الأطعمة والعلاجات باهظة الثمن ، كل هذا خرافة .و سنكون أفضل حالاً باتباع نظام غذائي صحي ومتوازن ، والكثير من النشاط البدني والنوم الجيد في الليل.

في ما يلي بعض الخرافات الغذائية التي يمكنك التفكير فيها

١- معظم الملح الذي نأكله يضاف على مائدة الطعام .

معلومة خاطئة.. في الواقع حوالي 4/3 من الملح الذي نأكله يوجد في الأطعمة المصنعة. لذا فإن إضافة الملح إلى مائدة الطعام يعني المزيد من الملح ! نحن نأكل حوالي 9 غم من الملح يوميًا (حوالي 2 ملعقة صغيرة).

يجب أن يستهدف البالغون أقل من 6 غم / يوم (1 ملعقة صغيرة) للمساعدة في الوقاية من ارتفاع ضغط الدم أو التحكم به ؟

٢- إن تناول مكملات غذائية من الفيتامينات يعني أنه يمكنك تناول أطعمة صحية أقل بدلاً من ذلك.

معلومة خاطئة.. لن توفر لك مكملات الفيتامينات جميع العناصر الغذائية التي يحتاجها جسمك بشكل يمكن استخدامه بسهولة ، ولن يعطيك الطاقة أو المعادن أو أي عوامل أخرى مهمة موجودة في الطعام الطبيعي.

٣- الفواكه والخضروات الطازجة صحية أكثر من المجمدة.

معلومة خاطئة. غالبًا ما تحتوي الفواكه والخضروات المجمدة على المزيد من الفيتامينات والمعادن حيث يتم تجميدها حالما يتم حصادها ، وبالتالي يتم الحفاظ على محتوى المواد الغذائية. كما أنها لا تفقد كميات كبيرة من العناصر الغذائية أثناء التخزين و النقل

٤- مشروبات الدايت لن تدمر أسنانك لأنها خالية من السكر.

معلومة خاطئة . مشروبات الدايت شديدة الحموضة ، لذا فإن شربها بانتظام قد يؤدي إلى الإضرار بأسنانك عن طريق إتلاف طبقة المينا الواقية الموجودة على السطح الخارجي لأسنانك. إذا كنت ترغب في شرب مشروبات الدايت ، فمن الأفضل التقليل منها و شربها في أوقات الوجبات فقط .

5- الزبدة لديها دهون أكثر من السمنة

كذبة أحيانًا. تحتوي الزبدة والسمنة على نفس الكمية من الدهون.

علامات على أن النظام الغذائي غير صحي :

- أي نظام غذائي يعزز فقدان الوزن السريع على سبيل المثال تصغير مقاس الفستان في أسبوع ليس فقط أمرًا صعبًا فحسب ، بل من المرجح أن يؤدي إلى فقدان العضلات وكذلك الدهون. يوصى بفقد 1 كيلوغرام (2 باوند) أسبوعيًا كحد أقصى ، حيث من المرجح أن تحرق الدهون وتتبع نظامًا غذائيًا يمكنك الحفاظ عليه.

• نظام غذائي يدعي أن تتناول أطعمة معينة فقط سيساعد على حرق الدهون على سبيل المثال: حماية حساء الملفوف . فالنظام الغذائي الذي ينطوي على تناول الكثير من عنصر غذائي واحد أو مجموعة غذائية واحدة غير متوازن ، ومن المرجح أن يكون منخفضًا جدًا في السعرات الحرارية والبروتين والكربوهيدرات والفيتامينات والمعادن. وبما أن النظام الغذائي مقيد للغاية ، فمن الصعب اتباعه، وهذا غالبًا ما يؤدي إلى الفشل. فمن الأفضل تناول نظام غذائي يشمل المجموعات الغذائية جميعها

اتباع نظام غذائي يمنع مجموعات غذائية كاملة على سبيل المثال. حمية اتيكنز. تحتاج إلى مجموعة متنوعة من مجموعات الطعام من نخلة الغذاء للحصول على نظام غذائي صحي ومتوازن. إذا كنت تتفادى مجموعة طعام تمامًا ، فستفقد المغذيات الحيوية التي تحتاجها من أجل صحة مثالية.

صفحة النشاط

التأكد من أن نظامك الغذائي متوازن

ما هي المجموعات الغذائية التي تأخذ منها وجباتك الخفيفة؟

لقد شرحنا الاختلافات بين اتباع نظام غذائي صحي واتباع نظام غذائي مبتدع؟. أيضا ، لقد تعرفنا في السابق على المجموعات الغذائية الرئيسية وناقشنا كيفية البدء في إجراء التغييرات. يجب أن تكون الآن على دراية جيدة وتمكينك لتحسين نمط حياتك و حياة عائلتك.

حاول الاحتفاظ بسجل عن أنواع الوجبات الخفيفة التي تعطيها لأطفالك باستخدام الجدول أدناه. ويمكن استخدامه لمعرفة مدى توازن النظام الغذائي الخاص بك .

املئي الفراغات في الجدول أدناه وفكري في وجبات طفلك وإلى أي مجموعات غذائية تنتمي لتكون وجباتهم متنوعة ومتوازنة من جميع المجاميع الغذائية

الأحد	الثلاثاء	الأربعاء	الخميس	الجمعة	الحدائق والفواكه والخضروات	الخبز، الأرز، البطاطس و المعكرونة	الحليب ومنتجات الألبان وبدائل الحليب	اللحوم، السمك، البيض، المكسرات والبقوليات
						مثال: كعك غير محلى		
							مثال: جبنة بيضاء	
					مثال: كمثرى			
								مثال: بسكويت مع الحمص

Appendix O: COVID-19 anthropometric measurements guidelines for remote consultation

**الجمعية البريطانية للتغذية
اللجنة المتخصصة بالأطفال
الإرشادات والتوصيات الخاصة باستشارات التغذية عن بعد
في ظل جائحة كورونا المستجد كوفيد-19**

هذه الارشادات تم اعدادها من قبل

د. لويز ماريون التي تحمل درجة دكتوراه وهي أيضا اخصائية تغذية علاجية معتمدة

أكاديمية وأخصائية تغذية علاجية متخصصة في الأطفال

وحدة العناية المركزة الخاصة بالأطفال – وحدة أمراض القلب-وحدة العناية بالرضع

الهاتف: 02381206072

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د. روزان ماير التي تحمل درجة دكتوراه وهي أيضا اخصائية تغذية علاجية معتمدة

محاضر بالكلية الملكية بلندن

شارع بريد -منطقة بادينقتون - لندن

البريد الإلكتروني: r.meyer@imperial.ac.uk

تمت المراجعة من قبل

الجمعية البريطانية للتغذية – اللجنة المتخصصة بالأطفال



مقدمة

في ظل جائحة فيروس كورونا المستجد كوفيد-19 و فإنه قد أصبح من الضروري استبدال طرق اخذ القياسات التقليدية التي تتضمن الاجتماع بالأطفال وعائلاتهم وجها لوجه بالتفاعل عن بعد عن طريق تطبيقات التواصل باستخدام كاميرا الفيديو او من خلال الهاتف. وهكذا فإن الطرق التقليدية لجمع المعلومات واخذ القياسات كجزء من العمل الاكلينيكي قد لا تكون ملائمة في ظل الوضع الراهن.

الهدف

الهدف من اعداد هذا الارشادات والتوصيات هو تقديم بعض المعلومات القابلة للتطبيق بالإضافة الى المراجع المناسبة ليتم استخدامها من قبل اخصائي التغذية الاكلينيكية بالتعاون مع العائلات لضمان نجاح الاستشارات التغذوية التي يتم تنفيذها عن بعد بقدر الإمكان. ذلك سيتم من خلال التأكد من تطابق أسس تقييم الحالة الغذائية والاستجابة لبرامج تحسين الحالة الغذائية.

قياس الوزن

للأطفال الذين تتجاوز أعمارهم السنتين

- يرجى أخذ وزن الطفل والتأكد من ان الميزان قد تم تنظيفه باستخدام مسحات معقمة لأن الطفل سيقف عليه وهو حافي القدمين. يرجى مساعدة الطفل على نزع الحذاء والجوارب وان يأخذ قياس الوزن اثناء ارتداء الطفل لملابس خفيفة.
- يرجى مساعدة الطفل على الوقوف في منتصف الميزان مع تباعد القدمين قليلا وان يقف معتدلا الى ان يظهر قياس الوزن.
- يرجى تسجيل الوزن الى أقرب رقم 0.1 كم وقم بتكرار عملية اخذ قياس الوزن. بعد الانتهاء من عملية اخذ قياس الوزن فبإمكان الطفل العودة الى كل ما كان يرتديه.

قياس الطول

للأطفال الذين تتجاوز أعمارهم السنتين

هذه الطريقة ليست دقيقة تماما ولكن يمكن استخدامها كبديل في ظل غياب الوسائل الأكثر دقة لقياس الوزن. وهي ليست طريقة منصوص باستخدامها بشكل دائم، وانما مؤقتا. يمكن تصميم جهاز قياس الطول باستخدام شريط القياس وكتاب وجدار أملس. من اجل محاولة محاكاة الصورة بالأسفل قم بلصق قطعة من الورق على الجدار خلف المنطقة التي يجب ان يكون رأس الطفل عليها.

- يرجى التأكد من ان الطفل نزع حذاءه وجواربه وأي قطع تزين الشعر، أيضا تأكد من ان الطفل يرتدي ثياب خفيفة بحيث تتمكنك من التأكد من ان اكتاف الطفل ووركه تلامس الجدار الاملس.
- يرجى مساعدة الطفل على الوقوف بمحاذاة الجدار بحيث تكون كل من عظمة الكتف والورك والكعب والقدمين ملامسه للجدار. يجب ان يكون جذع الطفل متزنا ومتسقا مع وضعية الوسط بحيث الا يكون مائلا الى المام ولا الى الخلف وانما بشكل مستقيم.
- يرجى مساعدة الطفل على موازنة وضعية رأسه بحيث يتوازي الخط الافقي الذي يصل اعلى الاذنين والعينين مع القاعدة. اثناء الحفاظ على الوضع المستقيم للرأس ويرجى طلب المساعدة من شخص اخر بحيث يضع غلاف مقوى لأي كتاب متوفر فوق رأس الطفل.
- يرجى وضع علامة على الورقة التي تم الصاقها على الجدار مسبقا ثم نطلب من الطفل ان يغادر كي يتسنى استخدام شريط القياس لقياس المسافة بين الأرض والعلامة التي تم وضعها على الورق (يرجى رؤية الصورة المرفقة). يجب اخذ القياس بدقة الى أقرب 0.1 سم.



قياس طول الطفل

Appendix P: participates adherence to the intervention component

Child attendance rate for the intervention sessions

ID	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	# Attended sessions	Attendance rate (%)
HLI02	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No	No	8	66.7
HLI03	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	10	83.3
HLI06	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	9	75
HLI08	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	10	83.3
HLI10	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	11	91.7
HLI12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	11	91.7
HLI13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	10	83.3
HLI16	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	9	75
HLI18	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	91.7
HLI21	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	10	83.3
HLI26	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	9	75
HLI27	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	11	91.7
HLI29	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	11	91.7
Total													Mean (SD)	percentage
													10 (1.0)	83

Mothers' attendance rate

	1	2	3	Attended sessions	Attendance rate (%)
HLI02	1	0	1	2	66.7
HLI03	1	1	1	3	100
HLI06	1	1	0	2	66.7
HLI08	1	1	1	3	100
HLI10	1	1	0	2	66.7
HLI12	1	1	1	3	100
HLI13	1	1	0	2	66.7
HLI16	0	1	1	2	66.7
HLI18	1	0	1	2	66.7
HLI21	1	0	0	1	33.3
HLI26	0	1	0	1	33.3
HLI27	0	1	1	2	66.7
HLI29	1	0	1	2	66.7
Total				Mean (SD)	Percentage
				2 (0.6)	66.7