CANCER SCREENING AS A TEACHABLE MOMENT FOR RISK REDUCTION BEHAVIOUR

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A thesis submitted for the degree of Doctor of Philosophy

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Declaration

I, Claire Stevens, 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 in the thesis.
Acknowledgements

Firstly I would like to thank my academic supervisors, Becca, Jo, Charlotte and Sam. Thank you for your continuous support, for nurturing my ideas, and for giving me the confidence and skills to grow as a researcher. Thank you for sticking with me throughout your own career transitions; it has been a pleasure and an inspiration witnessing your successes over the years.

Thank you to my colleagues at the BSH. The Cancer Screening and Energy Balance research groups have taught me the importance of collaboration and community within research. The opportunity to share my ideas and work in progress with so many brilliant people has been invaluable. A special thanks goes to the PhD room. You have been my cheerleaders, cake-bakers, and sources of the juiciest gossip. But most importantly, you have been a font of knowledge and support.

Thank you to my parents, who bravely promise that they will read this thesis from cover to cover! I'm not sure it's possible to summarise your support in just a couple of sentences. But, you have taught me the value of education, and you have always encouraged me to pursue my interests. Also thank you to my brother and sister, who are always at the end of the phone with words of encouragement, humour and perspective.

Finally, Iwan. Thank you for making me laugh every day, even on the days where this PhD seemed insurmountable — this journey would not have been possible without your love and support. I promise I'll catch up on all the cooking, cleaning and laundry that I delegated to you over the final few months!
Abstract

Cancer screening could be a teachable moment for health behaviour change. This thesis explored whether cancer screening participation (breast, bowel, cervical, lung) could be a prompt for spontaneous behaviour change, or an opportunity to deliver behavioural cancer prevention interventions.

A systematic review explored spontaneous health behaviour change following participation in breast, bowel, cervical and lung screening (Study 1). There was limited support for screening as a prompt for spontaneous behaviour change. In study 2, a sample of screening-naïve men was identified in the English Longitudinal Study of Ageing (n=774). Data indicated that Faecal Occult Blood Testing (FOBT) participation might prompt small positive changes to vigorous physical activity.

Study 3A (n=1,037) found most breast, bowel and cervical screening intenders were willing to receive lifestyle advice in a hypothetical screening scenario, even if results require further investigations. Two-thirds of screening intenders were willing to receive advice about diet, weight and physical activity (Study 3B; n=1,221). Interest in advice about smoking and alcohol consumption was lower. In a hypothetical lung screening scenario, most screening intenders were willing to receive lifestyle advice alongside screening, more so if results require further investigations (Study 4; n=459). Half were interested in advice about smoking cessation. There was also some interest in advice about diet, weight, physical activity and alcohol consumption.

An in-depth, qualitative exploration of openness to receiving lifestyle advice alongside cancer screening was conducted among 30 breast, bowel and cervical screening attendees (Study 5). Receptivity was influenced by individuals’ affective response to cancer screening and how advice would be delivered. Four distinct types of receptivity to advice were identified. This study does not support a ‘one-size-fits-all’ approach to intervention delivery in this setting.

Together, findings from this thesis suggest that in the absence of spontaneous behaviour change, targeted interventions and advice may be welcome in the context of cancer screening.
Impact statement

There is convincing evidence linking a range of health behaviours with a number of common cancers. Understanding how best to support positive health behaviour change is a public health priority. Cancer screening has been described as a teachable moment for behavioural cancer risk reduction. The research presented within this thesis, which explores cancer screening as a teachable moment, has the potential for impact both inside and outside of academia.

Within academia, this thesis contributes towards the conceptualisation of the teachable moment at cancer screening. This thesis explores whether participation in cancer screening may prompt spontaneous positive changes to cancer risk behaviours, as well as exploring whether cancer screening is an opportunity to provide behavioural support and interventions. Novel methodological approaches were employed to understand the teachable moment, including using prospective cohort data to assess whether cancer screening prompts spontaneous behaviour change, and conducting in-depth data-prompted qualitative interviews to better understand how the screening experience influences the teachable moment. These methodologies provide new insights into cancer screening as a teachable moment. The insights gained throughout this thesis have the potential to inform future research.

A further demonstration of the academic impact of this thesis is the successful dissemination of the research. To date, three of the five studies have resulted in four peer-reviewed publications. In addition, the research has been presented at conferences both within the UK and internationally.

Outside of academia, the research presented in this thesis also has the potential to impact practice. There was little evidence that cancer screening prompts spontaneous health behaviour change. However, this thesis indicates that the implementation of behavioural interventions alongside cancer screening programmes is generally acceptable. This thesis provides valuable information about screening participants’ preferences for the delivery of lifestyle advice at cancer screening, as well as information about factors that influence receptivity to advice.
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Contributions to the work carried out in this thesis

I designed and carried out the studies reported in this thesis, together with my supervisors Dr Rebecca Beeken, Dr Jo Waller, Dr Samuel Smith and Dr Charlotte Vrinten. Details of my contributions towards the individual studies are listed below. This PhD was supported by a Cancer Research UK Studentship (C416/A19488). Individual studies were funded using the above studentship unless otherwise stated.

For Study 1 (Chapter 3), I prepared the review protocol and registered it on the PROSPERO online database. I developed the search strategy and carried out the online searches. I assessed the titles of records for eligibility, of which 10% were reviewed by Dr Rebecca Beeken. Then I assessed abstracts and full texts of records for eligibility (100% of full-text records were second coded by Dr Rebecca Beeken). I extracted the data from full-text records, which were checked for accuracy by Dr Charlotte Vrinten. I summarised and synthesised the data, as presented in this thesis.

Study 2 (Chapter 4) involved secondary analysis of data from the English Longitudinal Study of Ageing, a prospective cohort study of English Adults. For Study 2, I developed the research questions and analysis plan. With assistance from Dr Lindsay Kobayashi, I prepared the dataset with relevant variables from waves 4-7. I conducted the data analyses and interpretation presented in this thesis. I prepared, submitted and revised a manuscript, which was accepted for publication in the Journal of Medical Screening.

Study 3 (Chapter 5) was conducted as part of the Attitudes, Behaviour and Cancer UK Survey (ABACUS), which is led by researchers from UCL’s Department of Behavioural Science and Health. I developed the research questions presented in Chapter 3. I assisted with the UCL research ethics application. I was involved in selecting and piloting items for the main survey, and generated items used to examine the acceptability of lifestyle advice at cervical, breast and bowel cancer screening. I conducted the analyses and interpreted the data presented in Chapter 3. I prepared two manuscripts using the data from this study and responded to reviewers’ comments. The manuscripts were accepted in Preventive Medicine and the British Journal of Cancer.
The data for study 4 (Chapter 6) were collected as part of the Smoking Toolkit Study, which is led by researchers from UCL’s Department of Behavioural Science and Health. Together with Dr Samantha Quaife, I prepared the ethics application required to add items to the monthly Smoking Toolkit Study. I generated the research questions, analysed and interpreted the data presented in study 4. Using the data collected in study 4, I prepared a manuscript and responded to reviewers’ comments. The manuscript was accepted for publication in the journal Lung Cancer.

Study 5 (Chapter 7) was nested within a larger project called Conversation Time. The wider project aimed to explore the feasibility and potential predictors of openness to a conversation about physical activity alongside cancer screening. The project was a collaboration between researchers from the University of Aberdeen, University of Southampton, University of East Anglia, Queen Mary University of London and UCL. I contributed towards the UCL ethics application. I programmed and tested the app, which was used for data collection. I helped with recruitment, including the commissioning of a participant recruitment agency (Saros Research Ltd.). Throughout the study, I was responsible for participant management. This involved assessing participant eligibility, ensuring that people were correctly enrolled in the study app, and responding to participant queries. Study 5 was a qualitative study which used data from the Conversation Time project as a basis for data-promoted interviews. I developed the research questions and interview schedule. I recruited and re-consented participants who took part in the Conversation Time study. I prepared the quantitative data, which was distributed to participants prior to the data-promoted interviews. I conducted the interviews. The interviews were transcribed by an external company (Devon Transcription Ltd.). Using the transcripts, I developed the analytic framework. A subsample of transcripts was analysed by a second researcher (Dr Anna Roberts). The Conversation Time project was funded by Cancer Research UK as part of an Innovation Grant awarded to Dr Rebecca Beeken. Supplementary funds from the Cancer Research UK studentship awarded to support this PhD were used for the qualitative component of the Conversation Time project.
Publications

The following peer-reviewed publications and conference presentations have resulted from the work presented in this thesis:

**Peer-reviewed publications**


**Oral conference presentations**


**Stevens, C.**, Smith, S., Vrinten, C., Waller, J., & Beeken, R. Using prospective cohort data to investigate if colorectal cancer screening is a teachable moment for behaviour change: findings from the English Longitudinal Study of Ageing. *UK Society for Behavioural Medicine 12th Annual Scientific Meeting, 1st-2nd December 2016, Cardiff*. (Oral presentation as part of a symposium on Teachable Moments).

**Poster presentations**

Chapter 1. Introduction

1.1 The importance of cancer prevention

1.1.1 Cancer mortality, incidence and prevalence in England

Cancer has been the most common cause of mortality in England since 2011, accounting for 28.2% of all deaths reported in 2018 (Office for National Statistics, 2019c). Five-year cancer survival rates have improved in recent years, however, survival is highly dependent on the type of cancer diagnosed and stage of diagnosis (Office for National Statistics, 2019b). Despite improvements in cancer survival, the incidence of cancer is increasing (Office for National Statistics, 2019a). There were more than 300,000 new diagnoses of cancer, excluding non-melanoma skin cancer, in England in 2017 (Office for National Statistics, 2019a). Breast cancer was the most commonly diagnosed cancer accounting for 15.1% of all diagnoses, closely followed by prostate (13.5%), lung (12.7%) and colorectal cancers (11.4%). Recent estimates suggest one in two adults born after 1960 will develop cancer in their lifetime, with slightly higher rates among men (53.5%) than women (47.5%; Ahmad, Ormiston-Smith, & Sasieni, 2015). Improvements in cancer survival and increases in cancer incidence mean that cancer is a highly prevalent disease. As a result, it is estimated that almost two million people are living with and beyond a diagnosis of cancer in England (Maddams, Utley, & Moller, 2012; Transforming Cancer Services Team, National Cancer Registration and Analysis Service, & Macmillan Cancer Support, 2018). The high incidence, prevalence and mortality of this disease mean that cancer prevention is a leading public health priority (NHS England, 2016).

1.1.2 Cancer prevention in England

The recent NHS Long Term Plan places a strong emphasis on the prevention of disease and describes a commitment to strengthen the NHS contribution towards preventive services (NHS, 2019c). In addition, cancer-specific public health strategies have proposed targeting modifiable cancer risk factors to reduce the growth in cancer incidence and to improve cancer outcomes (NHS England, 2016; The Independent Cancer Taskforce, 2015). Cancer prevention can broadly be split into three objectives, primary, secondary and tertiary prevention, each targeting a different
component of cancer control (Gordon, 1983). Primary prevention is concerned with reducing 
cancer incidence by targeting modifiable risk factors for cancer such as behavioural determinants, 
or by preventing known precursors of cancer, such as strains of human papillomavirus (HPV) 
implicated in the development of cervical cancer. Secondary prevention is concerned with the 
early detection of cancer, or with the detection of pre-cancerous processes, which can be 
interrupted to prevent the development of cancer. Tertiary prevention of cancer relates to the 
 improvement of disease outcomes such as survival and recurrence within populations who have 
already developed a disease. This thesis will include aspects of primary and secondary prevention 
by exploring the integration of behavioural cancer risk reduction (primary prevention) within 
cancer screening settings (secondary prevention).

1.1.3 Primary prevention of cancer and modifiable risk factors

Primary prevention of cancer is reliant on understanding the mechanisms involved in the 
development of cancer and identifying targets suitable for intervention. In England, it is estimated 
that 37.3% of all cancers are attributable to potentially modifiable lifestyle-related and 
environmental risk factors (Brown et al., 2018). Of the most prevalent cancers in England, 78.9% 
of lung cancers, 54.1% of colorectal cancers and 22.9% of breast cancers are deemed 
preventable through fourteen known risk factors. These risk factors include exposures such as 
air pollution and ionising radiation, but also health behaviours and outcomes such as smoking 
and physical inactivity. This thesis will explore several of these risk factors as targets for 
behavioural cancer prevention: tobacco smoking, overweight and obesity, alcohol consumption, 
dietary factors, and insufficient physical activity. These behaviours will be summarised in relation 
to the most common cancers, with emphasis on cancers currently screened for in England.

1.1.3.1 Tobacco smoking

Tobacco smoking, hereafter referred to as smoking, is the single greatest preventable contributor 
to cancer incidence, with an estimated 14.7% of all cancer cases in England attributable to this 
risk factor (Brown et al., 2018). Almost three-quarters of lung cancers (72.0%) are attributable to 
smoking, suggesting a large proportion of this highly prevalent cancer could be prevented by 
reducing smoking rates. Smoking is not only associated with lung cancer incidence but with 14
Chapter 1. Introduction

other cancers, including cancers of the bowel (6.8% attributable) and cervix (20.3% attributable). There is no safe level of smoking (Inoue-Choi et al., 2017). Therefore, complete abstinence is recommended. The latest Health Survey for England data indicates that 17% of the English adult population currently smoke (NHS Digital, 2018b). Rates of smoking in the UK are in decline, having fallen from 27% in 1993.

1.1.3.2 Overweight and obesity

It is estimated that 6.3% of all cancers in England are attributable to overweight and obesity (Brown et al., 2018). Body mass index (BMI; kg/m\(^2\)), a ratio of a person’s weight to height, is commonly used as a way of categorising weight status in adults. A BMI of 18.5-24.9 is considered to be within the normal range, a BMI equal to greater than 25 is classified as pre-obese (hereafter referred to as overweight), and a BMI greater than 30 is classified as obese (World Health Organization, 2019a). Overweight and obesity have been linked to thirteen cancer types, including 11.5% of bowel cancers and 8.3% of breast cancers (Brown et al., 2018).

Over the last 10 years, the World Cancer Research Fund (WCRF) has appraised evidence on the link between factors such as overweight and obesity and cancer as part of their Continuous Update Project (World Cancer Research Fund & American Institute for Cancer Research, 2018). The WCRF’s most recent report summarises the strength of evidence for a number of modifiable exposures linked to the most common cancers. The WCRF meta-analyse epidemiological data and data from randomised controlled trials (RCTs) of experimental human and animal studies (World Cancer Research Fund/American Institute for Cancer Research). The majority of research on behavioural risk factors for cancer is observational. Therefore, it is difficult to draw causal inference between risk factors and cancer outcomes. For each exposure and outcome, the WCRF grades the available evidence: convincing (strong evidence), probable (strong evidence), limited suggestive, limited no conclusion, and substantial effect of risk unlikely.

The WCRF concluded there is strong evidence that adult body fatness increases the risk of colorectal cancer (World Cancer Research Fund & American Institute for Cancer Research, 2018). However, the relationship between body fatness and breast cancer is more complicated.
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There is strong evidence that adult body fatness increases the risk of postmenopausal breast cancer but decreases premenopausal breast cancer risk. Weight gain in adulthood has been found to increase postmenopausal breast cancer risk. There was limited suggestive evidence that body fatness increases cervical cancer risk. The WCRF recommends that weight be kept within a healthy range (BMI 18.5-24.9), and to avoid weight gain in adulthood. Findings from the 2017 Health Survey for England report two-thirds of English adults are living with overweight or obesity (67% of men and 62% of women), with almost one-third of people categorised as obese (27% of men and 30% of women; NHS Digital, 2018b). The proportion of English adults who are affected by overweight and obesity is increasing over time, rising from 53% in 1995.

When considering overweight and obesity as a risk factor for cancer, it is important to note that this risk factor is not a behaviour. Rather, obesity has a number of socioeconomic, environmental, and behavioural determinants (World Health Organization, 2014). The concept of energy balance (energy intake vs energy expenditure) can be used to understand some of the behavioural determinants of obesity (Spiegelman & Flier, 2001). However, energy balance behaviours are distinct cancer risk factors and the evidence linking these behaviours to cancer is discussed below.

1.1.3.3 Dietary factors

As well as contributing to overweight and obesity, various dietary factors are independently implicated in the development of cancer. The WCRF recommends a range of dietary cancer prevention behaviours, including consuming a diet rich in whole grains, vegetables, fruits and beans, to limit the consumption of red and processed meat, and to avoid processed foods high in fats, starches and sugars. Insufficient fibre is thought to account for 29.8% of colorectal cancers (3.5% of all cancers) and an additional 13.4% of colorectal cancers are attributable to the consumption of processed meat (1.6% of all cancers; Brown et al., 2018). The WCRF reports strong evidence for the consumption of whole grains and dietary fibre for colorectal cancer prevention, and strong evidence linking red and processed meat consumption to increased colorectal cancer risk (World Cancer Research Fund & American Institute for Cancer Research, 2018). There was also limited suggestive evidence for the protective effect of non-starchy
vegetables, fruit and fish for colorectal cancer. Regarding breast cancer risk, there was limited suggestive evidence that consumption of dairy products reduces premenopausal breast cancer risk, and that the consumption of non-starchy vegetables reduces the risk of oestrogen receptor-negative breast cancer.

The role of nutritional epidemiology in understanding the impact of diet on health-related outcomes has been a topic of debate for more than thirty years (Willett, 1987). One of the key issues is that diet is a complex interaction of multiple nutrients, food groups and dietary patterns. Therefore, understanding how single factors influence outcomes is difficult. Furthermore, measuring diet is incredibly complex (Shim, Oh, & Kim, 2014). Most measures of diet are subjective self-reports, and therefore, are open to bias. One of the most commonly measured dietary risk factors is fruit and vegetable consumption. In the UK, it is recommended that people consume at least five portions of fruits and vegetables per day (Public Health England, 2016a). Less than one-third (29%) of English adults meet this recommendation (NHS Digital, 2018b). Specific recommendations for fibre intake suggest adults should consume 30g of dietary fibre per day (Public Health England, 2015). However, just 13% of men and 4% of women aged 19-64 are thought to meet these guidelines (Food Standards Agency & Public Health, 2018).

This thesis will focus on the consumption of foods linked to the development of cancer, rather than individual nutrients or wider dietary patterns.

1.1.3.4 Physical inactivity

Physical inactivity accounts for 4.6% of all bowel cancers in England, and 0.5% of all cancers (Brown et al., 2018). According to the WCRF, there is strong evidence that being physically active decreases colon and postmenopausal breast cancer risk, with additional evidence to suggest that vigorous physical activity decreases pre- and postmenopausal breast cancer risk (World Cancer Research Fund & American Institute for Cancer Research, 2018).

Physical activity is a crucial energy balance behaviour and includes any movement that expends more energy than at rest (World Health Organization, 2018). There are many ways to classify levels of physical activity. In the United Kingdom guidelines are based upon participating in
moderate physical activity (150 minutes per week), vigorous physical activity (75 minutes per week), or a combination of both moderate and vigorous physical activities (Department of Health and Social Care, 2011). Physical activity is commonly described using METs (Metabolic Equivalents), a ratio of working metabolic rate relative to resting metabolic rate (World Health Organization, 2019b). Moderate physical activity is described as any activity that elicits increased heart rate and breathing while remaining able to talk, and is approximately 3-6 METs; i.e. activity which expends 3-6 times the activity expended at rest. Vigorous physical activity is described as any activity which elicits a fast heart rate and breathing to an extent which makes talking difficult and is approximately six METs or higher. The latest physical activity guidelines also highlight the importance of reducing sedentary behaviour by sitting less and taking part in activities that build strength or improve balance on two days per week (Department of Health and Social Care, 2011). The most recent Sport England Active Lives Survey found that a third (36.8%) of English adults were falling short of guidelines to meet 150 minutes of moderate physical activity or equivalent, with a quarter of the population (24.8%) participating in less than 30 minutes of activity per week (Sport England, 2019).

1.1.3.5 Alcohol consumption

Alcohol consumption is estimated to account for 3.5% of all cancers, including 5.9% of bowel cancers and 7.7% of breast cancers (Brown et al., 2018). The WCRF reports strong evidence linking the consumption of alcoholic drinks with six cancers, including colorectal cancer and pre- and postmenopausal breast cancers (World Cancer Research Fund & American Institute for Cancer Research, 2018). Limited evidence was also present for an additional three cancers, including lung cancer. However, as with many behavioural outcomes, human studies exploring the impact of alcohol consumption on cancer incidence are largely observational, making a causal relationship difficult to confirm. Furthermore, measurement issues in alcohol consumption (e.g. underestimation of alcohol consumption in self-report) complicate the generation of estimates of the impact of alcohol consumption on cancer incidence (Zakhari & Hoek, 2018).

The WCRF recommends that for cancer prevention, it is best to avoid drinking alcohol. The latest guidelines on alcohol consumption issued by the UK Chief Medical Officer recommend not to
regularly drink more than 14 units a week for both men and women, and to spread alcohol consumption evenly over three or more days (UK Chief Medical Officer, 2016). These guidelines replaced recommendations for women not to exceed 14 alcoholic units per week and for men not to exceed 21 alcoholic units per week. Among English adults, 28% of men and 14% of women drank more than the recommended weekly 14-unit limit in 2017 (NHS Digital, 2019b). Men and women aged 55-64 were most likely to exceed alcohol consumption guidelines.

1.1.3.6 Clustering of cancer risk factors

As part of the Health Survey for England, 2017, the prevalence of five behaviours were combined to estimate the distribution of multiple risk behaviours within the English population: smoking, alcohol consumption >14 units per week, fruit and vegetable consumption < 5 portions per day, physical activity, and obesity (NHS Digital, 2018b). Just 13% of the adult population had none of the risk factors; around half of the population had two or more risk factors. Various research has explored the clustering of behavioural cancer-related risk factors, including two systematic reviews (Meader et al., 2016; Noble et al., 2015). In a review of almost 40 UK based studies exploring clustering of health behaviours, two smoking-related clusters were identified, one with alcohol consumption and another with unhealthy dietary behaviours (Meader et al., 2016). In a second systematic review of 56 studies, smoking and alcohol consumption were found to be clustered in more than half of the studies identified (Noble et al., 2015). In addition, clustering of all four behaviours included in the review (smoking, poor nutrition, excess alcohol consumption and physical inactivity) was reported in half of the included studies. In light of the high prevalence of multiple cancer risk behaviours within the population, and the clustering of behaviours, it is important to consider how best to target behavioural cancer prevention efforts.

1.2 Cancer Prevention and the teachable moment

The strength of the evidence linking lifestyle factors to the development of cancers, and the high proportion of individuals not adhering to lifestyle recommendations, highlights the need for behavioural cancer prevention strategies. Cancer screening has been identified as a potential ‘teachable moment’ for other cancer-preventive behaviours either through prompting spontaneous behaviour change or by providing an opportunity to deliver cancer prevention
advice. These different conceptualisations of the teachable moment will be discussed in more detail below.

1.2.1 Definitions of the teachable moment

The term teachable moment is often attributed to Robert Havighurst, who first wrote about teachable moments from the standpoint of educational development (Havighurst, 1953). Havighurst said of the teachable moment:

“When the body is ripe, and society requires, and the self is ready to achieve a certain task, the teachable moment has come”

(Havighurst, 1953, p5).

In the 65 years since this definition of the teachable moment was published, the term has been used with increasing regularity in academic literature. Almost 800 records identified by the Web of Science citation indexing service include the term in their title, abstract or keywords, half of which have been published within the last five years (Web of Science, 2019). Three-quarters of these records are related to health and health care, including subcategories such as general medicine, oncology and nursing.

A concept analysis of the teachable moment, published a decade ago, identified three ways in which the term was commonly used (Lawson & Flocke, 2009). The authors searched for uses of the term in several academic databases and identified 404 articles referencing the term. A random sample of 93 articles was selected for analysis. In around 80% of papers, the teachable moment referred to an opportunity to facilitate learning or change. Less than one in five papers used the term to retrospectively label situations where behaviour change, outside of the expected range, had occurred. Just two per cent of papers attempted to explain mechanisms behind the teachable moment. This paper highlights the contrasting ways that the term has been used to date, and the lack of proposed mechanisms to explain what makes a moment ‘teachable’.

This thesis will consider whether cancer screening is a teachable moment for behavioural cancer risk reduction. Taking a broad view of the conceptualisation of the teachable moment this thesis will explore whether cancer screening is a prompt for spontaneous behaviour change, an
opportunity to support behaviour change, and will consider potential mechanisms for behaviour change. An overview of literature exploring these three aspects of the teachable moment in relation to cancer screening are presented in sections 1.3, 1.4 and 1.5.

1.2.2 Cancer Screening in England

The UK National Screening Committee (UK NSC) provides recommendations to government ministers and the NHS about the implementation of screening programmes within England, Northern Ireland, Scotland and Wales. The UK NSC comprises a panel of experts who contribute to recommendations relating to 100 conditions, of which there are screening recommendations for 30 (UK National Screening Committee, 2019). The UK NSC currently recommends that the four UK governments implement systematic population screening programmes for breast, bowel and cervical cancers (UK National Screening Committee, 2019). However, the individual governments for each country within the UK have control over the implementation of these screening programmes. As a result, cancer screening can be organised differently across the four countries. The cancer screening programmes currently implemented in England are described below, alongside details of cancer screening programmes not currently recommended in England.

1.2.2.1 Breast cancer screening

An independent review of the benefits (e.g. cancer outcomes) and harms (e.g. overdiagnosis) of breast cancer screening estimated a 20% relative reduction in breast cancer mortality among women invited for screening (Marmot et al., 2013). Population breast screening has been in operation in England since 1988 (Advisory Committee on Breast Cancer, 2006). The English breast screening programme invites women aged 50-70 to attend every three years (England, 2015). In clinics or mobile screening units, mammography (an X-ray of the breast tissue) is used to detect breast cancers, making it a form of secondary prevention. Alongside the invitation to attend breast cancer screening women are given a leaflet which provides information about the screening procedure, potential screening results, risks and benefits of attending, and breast cancer symptoms (NHS, 2019a). The leaflet lists age as a risk factor for breast cancer but does not include other breast cancer risk factors such as lifestyle. There is currently a trial to evaluate
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the potential harms and benefits of extending the breast screening age range to 47-73 years, meaning women may receive an additional two breast screening invitations (Moser et al., 2011).

In the 2017-2018 year-long reporting period, 2,140,000 women (70.5% uptake) participated in the English breast screening programme (NHS Digital, 2019a). Therefore, NHS breast cancer screening has the potential to provide a teachable moment to a large number of women annually. However, while most women participate in breast screening in England, screening uptake varies according to sociodemographic factors including ethnicity and socioeconomic position. In 2012, 78.1% of women in the lowest quintile of deprivation participated in breast screening, compared with 69.8% of women in the highest quintile of deprivation (Douglas, Waller, Duffy, & Wardle, 2016). Another study found lower uptake of the first breast screening invitation among some ethnic minority groups (e.g. Bangladeshi 43%, Black African 49%), compared with white British Women (67%; Jack et al., 2014).

1.2.2.2 Bowel cancer screening

There are two bowel cancer screening programmes in operation in England. There have also been substantial changes to the recommendations made for one of the bowel screening programmes since the commencement of this doctorate.

*Flexible sigmoidoscopy*

Once fully operational, the first invitation that English adults will receive to participate in a bowel cancer screening programme is for Flexible Sigmoidoscopy (FS), also known as bowel scope screening. The UK NSC made the recommendation for FS as a bowel screening modality in 2011 (UK National Screening Committee, 2019). This recommendation was made following the completion of the UK FS trial, where more than 170,000 people were randomised to receive a one-off FS screening or to a control group (Atkin et al., 2010). Colorectal cancer incidence was reduced by 33% and mortality by 43% in the screened group. This bowel screening programme invites men and women at the age of 55 to take part in a once-only FS. During the procedure, a small camera is used to examine the distal bowel for abnormalities such as polyps. Polyps are small growths, which are usually harmless but could develop into cancer in the future. Polyps are
usually removed during the procedure. The removal of colorectal polyps reduces a person’s colorectal cancer risk, making this procedure a form of primary prevention. The FS screening leaflet posted alongside screening invitations contains a section about reducing bowel cancer risk (Public Health England, 2018). The leaflet states that participating in the screening is the best way to reduce bowel cancer risk, but also lists a range of lifestyle-related factors including physical activity, diet, alcohol consumption and smoking.

This screening programme is not yet fully implemented. An independent review of English cancer screening programmes suggests that FS bowel screening programme is failing to meet coverage targets, with less than 50% of the intended population invited by September 2018 (Richards, 2019). While the programme is not currently available to the whole population, data from the first 14 months of the programme suggests that uptake is low (McGregor et al., 2016). Only 43.1% of invitees participated, with higher rates of attendance among men compared with women (45% vs 42%). Additionally, sociodemographic variations in uptake were identified, with 33% of people from the most deprived areas attending compared with 53% of people from the least deprived areas. Uptake for this screening programme is considerably lower than for breast screening. It is important to consider how this may impact the teachable moment. One the one hand, FS may provide an opportunity to reach a substantial number of both men and women. This is in contrast to breast and cervical screening programmes which are limited to female populations. On the other hand, sociodemographic variations in screening uptake may mean that there are inequalities in who is exposed to the teachable moment.

**Faecal Occult Blood testing**

The implementation of Faecal Occult Blood Testing (FOBT) began in England in 2006 as part of the Bowel Cancer Screening Programme (Logan et al., 2012). The test detects hidden traces of blood in the stool, which can be an early warning sign of bowel cancer. FOBT is considered a secondary prevention measure as it aims to detect early cancers. Men and women are offered a home testing kit every two years between the ages of 60-74 years. People are required to provide two small samples of stool on three separate occasions on a single card, before posting the test kit back to a laboratory for analysis. The leaflet accompanying the test, designed to help people
make an informed decision about screening participation, lists physical inactivity, overweight, and dietary factors as risk factors for colorectal cancer (NHS, 2016). More than 1.7 million people took part in FOBT bowel screening within a year-long period (2017-2018), resulting in an uptake of 56.1% among invitees (England, 2019). The majority of people who participate in FOBT will have a clear result; however, an estimated 2.5% men and 1.5% women will have an abnormal test result requiring further investigations, such as colonoscopy (Logan et al., 2012). As with flexible sigmoidoscopy, there is sociodemographic variation in FOBT uptake (Hirst et al., 2018). Uptake is higher among women (56%), compared with men (47%). Furthermore, uptake is highest in the least deprived areas of England (57% vs 43%; lowest and highest quintiles of area-level socioeconomic deprivation) and the least ethnically diverse areas of England (56% vs 41%; lowest and highest quintiles of area-level ethnic diversity).

The teachable moment at FOBT may be different to the teachable moment at FS and other cancer screening programmes. Most FOBT participants will not have contact with a healthcare professional throughout the screening pathway unless they receive a result which requires further investigations. If contact with a healthcare professional is key to the creation of a teachable moment, this may negatively impact the teachable moment at FOBT. However, in contrast to FS, people are invited to participate in FOBT at several times throughout the life course, which may offer multiple opportunities to reinforce messages about cancer risk reduction.

**Faecal Immunochemical Testing**

In 2016, the UK NSC recommended that Faecal Immunochemical Testing (FIT) should replace FOBT (UK National Screening Committee, 2016). The Bowel Screening Programme began sending out FIT kits instead of FOBT kits from the beginning of June 2019. Similar to FOBT, FIT is a home test kit. However, FIT only requires recipients to provide a single stool sample, making it a more acceptable test among users. The age range (60-74) and screening interval (two years) remain unchanged. One meta-analysis reported higher uptake of FIT compared with FOBT (Vart, Banzi, & Minozzi, 2012). As well as potentially increasing uptake of the Bowel Screening Programme, the FIT may also be more effective at detecting bowel cancers (Moss et al., 2017).
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As FIT was not implemented when the research presented in this thesis was conducted, the use of ‘bowel screening’ refers to FOBT or FS unless otherwise specified.

1.2.2.3 Cervical cancer screening

There is a single cervical screening programme in operation in England; however, changes to the recommended cervical screening modality have been published since the commencement of this PhD.

Cytological cervical screening

Cervical screening has taken place in England since the 1960s. However, an organised screening programme was not implemented until the late 1980s (Albrow, Kitchener, Gupta, & Desai, 2012). To date, cervical screening, also known as the smear test, has used liquid-based cytology to look for abnormal cells in the cervix. Cervical screening is considered primary prevention as the primary aim is to identify and treat cell changes, most commonly cervical intraepithelial neoplasia, to prevent the development of cervical cancer. The test is offered every three years to women aged 25-49, and every five years to women aged 50-64. Data from 2017-2018 indicate that 71.4% of women are up to date with cervical screening, based on their age and screening interval (NHS Digital, 2018a). Almost 3.2 million women were tested in 2017-2018. However, the proportion of women up to date with cervical screening is in decline; 72.0% of women were up to date the previous year, and 75.7% were up to date in the period up to 2011. Almost all women (94.4%) will receive a negative screening result. The screening leaflet provided to women at the point of invitation lists smoking as a risk factor for cervical cancer and provides a link to the NHS SmokeFree website (NHS, 2019b).

Almost three-quarters of women participate in cervical screening, and women will receive up to 12 invitations to participate in their lifetime. Therefore, cervical screening may offer an opportunity to provide consistent cancer prevention advice and support throughout adulthood. However, in light of declining cervical screening uptake, it is important to consider the risks and benefits capitalising on the teachable moment at cervical cancer screening. Importantly, sociodemographic factors have been found to influence cervical screening uptake. Comparable with breast and bowel cancer screening, a similar pattern of deprivation level and screening
uptake is observed at cervical screening (Douglas, Waller, Duffy, & Wardle, 2016). As such, 80.2% of women in the lowest quintile of deprivation participated in cervical screening in 2012, compared with 75.3% of women in the highest quintile of deprivation. Furthermore, one study compared cervical screening attendance among women from Black, Asian and Minority Ethnic (BAME) groups with white British women (Marlow et al., 2015). Cervical screening non-attendance ranged from 44–71% among BAME women, but was just 12% among white British women. Therefore, it is important to consider the interplay between variations in screening uptake and the potential teachable moment.

**HPV primary screening**

Almost all cervical cancers (99.7%) are attributable to HPV (Brown et al., 2018). In 2016, the UK NSC recommended primary HPV testing as the preferred cervical cancer screening modality (UK National Screening Committee, 2016). The change in modality to HPV primary screening means that samples, collected in the same way as cytological cervical screening, will first be tested for the presence of HPV. If the sample is HPV positive, the sample will be tested again for abnormal cells. The age range and screening interval will remain largely unchanged (every three years to women aged 25-49, and every five years to women aged 50-64). Guidance for the implementation for HPV primary screening was published in February 2019 (Public Health England, 2019). As with the leaflet for cytological screening, the leaflet provided to women at the point of invitation to HPV primary screening lists smoking as a risk factor for cancer (NHS, 2019b). As HPV primary screening was not implemented when the research presented in this thesis was conducted, the use of ‘cervical screening’ refers to cytological screening, unless otherwise specified.

### 1.2.2.4 Lung cancer screening

In light of the high incidence of lung cancer (Office for National Statistics, 2019a), and strong evidence that early detection of lung cancer increases survival rates at one and five years post-diagnosis (Office for National Statistics, 2016), there is great interest in developing early detection strategies in this field. The UK NSC does not currently recommend population screening for lung cancer (UK National Screening Committee, 2019). However, a review of the recommendation is overdue (last review conducted in 2006), with the UK NSC awaiting the results of the NELSON
randomised lung screening trial (Ru Zhao et al., 2011). Results of the trial were presented at the World Conference on Lung Cancer in 2018 (De Koning, van Der Aalst, Ten Haaf, & Oudkerk, 2018). After ten years of follow-up, a 26% reduction in lung cancer deaths was observed among high-risk men who received a low-dose CT (computed tomography) lung screen. An even greater reduction in mortality was observed among the smaller subset of women included in the study. Several other large scale RCTs have tested the effectiveness of lung cancer screening in high-risk populations. The National Lung Screening Trial in the USA found that a screening programme consisting of three annual Low Dose CT (LDCT scans) reduced all-cause mortality by 6.7% compared with a single chest x-ray (Aberle et al., 2011). Data from the UK Lung Cancer Screening Trial suggest that LDCT screening of populations at high risk of lung cancer would be feasible in a UK population (Field, Duffy, Baldwin, Brain, et al., 2016).

Trials of lung cancer screening have targeted high-risk groups, rather than adopting a mass screening approach. Age and smoking history are two key risk factors in many lung screening criteria. Screening eligibility has varied between trials, and there is a need to refine methods of determining who is at high risk of developing lung cancer, and who would benefit most from participating in lung screening. Lung cancer screening for high-risk populations is now recommended in some countries, including the USA (U.S. Preventive Services Task Force, 2016) and a European position statement in favour of lung screening for high-risk populations was published in 2017 (Oudkerk et al., 2017). The identification of a high-risk target group, based partly on smoking status, may make lung screening an ideal setting in which to capitalise on the teachable moment.

1.2.2.5 The case for considering cancer screening as a teachable moment

Millions of interactions between patients and healthcare professionals are created each year as a result of organised population screening programmes for breast, bowel and cervical cancers in England. For example, there were 4.5 million invitations to cervical screening alone in 2017-2018, with 3.2 million women attending (NHS Digital, 2018a). This highlights the vast potential to understand health behaviour and to deliver messages about cancer prevention to a large proportion of English adults. Furthermore, new cancer screening programmes, such as lung
cancer screening, may provide opportunities to reach groups who stand to benefit greatly from behavioural support. Therefore, cancer screening is an ideal setting to investigate the topic of teachable moments.

1.3 Proposed mechanisms of the teachable moment at cancer screening

As highlighted in Lawson and Flocke’s 2009 concept analyses, few studies have attempted to identify mechanisms or apply theory to the teachable moment. Understanding the mechanisms involved in creating a teachable moment may help determine the impact of screening on health behaviour, and aid with the development of targeted and effective interventions. A key paper, published in 2003, attempted to understand the teachable moment for smoking cessation that has been observed in relation to a number of health settings and events (McBride, Emmons, & Lipkus, 2003). The paper reviewed literature that has explored health events and settings as cues to spontaneous changes to smoking behaviours.

In order to guide future research on the teachable moment, the authors developed a Teachable Moment Heuristic Framework, which proposes potential mechanisms of action (Figure 1.1). The framework overlaps with several existing theories of health behaviour, including the Health Belief Model (Rosenstock, 1974), the Theory of Planned Behaviour (Ajzen, 1991), Social Cognitive Theory (Bandura, 1998), the Precaution Adoption Process Model (Weinstein, 1988) and Stress and Coping Theory (Lazarus, 1993b). The heuristic framework suggests five key changes in response to a cueing event are responsible for the teachable moment: affective response, perceived risk and positive outcome expectancies, and self-concept and social role. In turn, these affect motivation, acquisition of skills and self-efficacy, leading to behaviour change. Brief definitions and examples of the five key components of the heuristic framework are presented below.
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1.3.1 Affective response

Teachable moments are thought to prompt an affective, or emotional, response. Affect is generally considered a two-dimensional construct, comprising positive and negative affect (Watson & Clark, 1997; Watson, Clark, & Tellegen, 1988). Positive affect is a term used to describe the extent to which a person is experiencing positive emotions or mood, such as enthusiasm, determination, or excitement. Conversely, negative affect is a term used to describe the extent to which a person is experiencing negative emotion or mood, such as distress, shame or nervousness. Positive and negative affect are thought to be independent constructs, and therefore, someone can experience an increase in positive and negative affect simultaneously. McBride and colleagues (2003) give the example of pregnancy as a health event that may elicit both positive and negative affect. For example, expectant parents may experience both excitement (positive affect) as well as nervousness (negative affect). It is theorised that affective responses may prompt behavioural responses, which can be either negative (avoidance) or positive (steps to reduce threat). Emotion-based coping is part of the Stress and Coping Theory

Figure 1.1. Adapted from the McBride et al., (2003) Teachable Moment Heuristic framework
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(Lazarus, 1993a), which suggests that people act in order to regulate emotional responses to events.

The emotional impact of screening was the focus of a systematic review and meta-analysis (Collins, Lopez, & Marteau, 2011). The review assessed 12 studies from a range of screening settings, including four set within cancer screening programmes. A meta-analysis of the 12 studies reported no impact of screening on longer-term anxiety, depression or quality of life subscales. However, there were limited studies exploring the short-term emotional response to screening. A study of psychological outcomes following LDCT screening in the UK found that cancer distress was higher in screened participants who received positive screening results, compared with unscreened participants at two-week follow-up (Brain et al., 2016). However, this effect had dissipated at two-year follow-up. Understanding the short-term impact of screening on affect is important when considering the timeliness of interventions aiming to capitalise on the teachable moment. If there is an affective response, which dissipates shortly after screening, then interventions may benefit from being delivered before the affective response returns to baseline levels.

Screening results are often found to influence screening participants’ affective responses. One study compared psychological responses to positive and negative FIT screening results (Bobridge, Bampton, Cole, Lewis, & Young, 2014). Measures of state anxiety, anger and depression were higher among people who received a positive FIT result, when compared with people who received negative FIT results. The difference between groups remained one year after people were notified of their screening results. While this study does not have an unscreened comparator group, it provides useful information about the potential impact of screening results on constructs thought to be important in creating a teachable moment. A recent cross-sectional survey explored psychological distress following an HPV positive screening result (McBride et al., 2019). Women receiving their first HPV positive result were found to be more anxious than controls, and women with an HPV positive result and abnormal cytology had higher levels of distress than controls. It is important to understand how affective responses to different screening results influence the teachable moment.
Limited research has explored how affective responses to screening relate to health behaviour change. In the context of lung cancer screening, one study examined cancer anxiety as a predictor of smoking cessation (Ostroff, Buckshee, Mancuso, Yankelevitz, & Henschke, 2001). The sample included 134 smokers, for whom smoking status was assessed before and after screening participation. The rate of smoking cessation at follow-up was 23%. Cancer anxiety was associated with smoking cessation, with 60% of people with high anxiety reporting either quitting or decreasing their smoking at follow up compared with 38% of people who scored low on measures of anxiety (OR 2.49, 95% CI 1.24-4.99).

Qualitative research has also attempted to understand the emotional impact of screening participation and how this might relate to behaviour change. Kathuria and Colleagues (2018) interviewed 21 physicians and 28 smokers following participation in lung screening. The emotional impact of screening was a concern for both physicians and screening attendees. Physicians felt that screening could increase receptivity by serving as a ‘wake-up call’ for patients, but acknowledged that a participant’s screening result was likely to serve a role in emotional response. Patients viewed lung screening as a cue for strong emotions, such as fear, which would, in turn, motivate behaviour change. Interviews of 37 lung screening attendees investigated how screening impacted motivations to quit smoking (Zeliadt et al., 2015). Screening participation elicited a range of emotions among participants, including worry, fear about potential results, and relief if the results were negative. A third qualitative study sampled 18 people with negative lung screening results and 13 people with positive screening results from a Scottish lung screening programme (Young et al., 2018). Many emotions were expressed in relation to screening results. Participants who received a negative screening result were relieved and reassured, compared with feelings of shock, worry and guilt expressed by participants with positive screening results. Emotional responses were tied to people’s motivations to quit smoking; however, there were individual differences in whether emotion led to motivation to quit. These studies are somewhat consistent with the Teachable Moment Heuristic Framework, which views emotional responses to screening as a precursor of motivation to quit smoking. The framework does not acknowledge potential individual differences in this effect. It is, therefore, important for studies to explore this further.
Overall the evidence to date suggests cancer screening participation does not appear to prompt a long-term affective response. However, short term affective responses may occur, particularly for people who receive positive screening results. Therefore, there is a need to further explore potential individual differences in affective responses to cancer screening, and how this may relate to health behaviour change, or receptivity to cancer prevention advice.

1.3.2 Perceived risk

Perceived risk is a common component of theories of health behaviour, such as the Health Belief Model (perceived susceptibility; Rosenstock, 1974). McBride and colleagues (2003) suggest that while people are generally optimistic about their risk, teachable moments increase the risk availability or salience. There are various conceptualisations of risk, and it has been proposed that risk is a multi-dimensional construct (Ferrer, Klein, Persoskie, Avishai-Yitshak, & Sheeran, 2016). Ferrer and colleagues (2016) propose that risk is three dimensional, with individuals appraising deliberative, affective and experiential risk perceptions. Deliberative risk relates to a person’s judgement of the likelihood of an event happening to them, for example, “On a scale from 0 to 100 %, how would you rate the probability that you will develop cancer in the future?” Affective risk relates to a person’s worry, fear, or emotional judgement about an event, for example, “How worried are you about developing cancer in the future?” Finally, experiential risk relates to rapid ‘gut-reaction’ estimations of risk, for example, “I feel very vulnerable to cancer”. The role of perceived risk in creating a teachable moment is not clear; it is also not known whether teachable moments influence multiple dimensions of risk perception. Furthermore, the McBride et al. (2003) model does not make the distinction between different types of risk perception.

Previous research has explored how participation in cancer screening programmes influences risk perceptions, to some extent. One study reported that for people with a negative lung cancer screening result, perceived risk decreases following the screening appointment (Byrne, Weissfeld, & Roberts, 2008). Within the same study, participants who received indeterminate screening results had short term increases in perceived risk, and participants who received suspicious screening results had long term increases in perceived risk. This finding suggests that the impact of screening on risk perceptions may be different according to different screening
results. Similarly, a study conducted by Bobridge and colleagues (2014) examined risk perceptions following FIT. The study compared risk perceptions among participants who received positive and negative FIT results. The authors found that perceived risk was greater in participants who received a positive FIT screening when compared with people who received negative FIT results. However, as the study did not include a control group or pre-screening measures of perceived risk, it is not possible to determine the extent to which screening alone influences risk perceptions.

As with affective responses to screening, few studies have linked risk perceptions at screening to behaviour change. A study which measured lung cancer risk perceptions at baseline and one-year follow-up found that changes in risk perceptions were not predictive of smoking cessation (OR 1.09, 95% CI 0.93-1.26; Park et al., 2013). Another study explored the role of cancer worry, personal risk, and health-related self-identity in engagement in a bowel cancer prevention intervention (McBride et al., 2008). Cancer worry (affective risk perception) was positively associated with intervention engagement. However, participants’ personal risk, based on a multiple risk factor score, was negatively associated with intervention engagement. Therefore, the current available evidence does not suggest a clear link between risk perceptions and the teachable moment at screening.

1.3.3 Positive outcome expectancies

Positive outcome expectancies refer to people’s judgements of the benefits of changing their behaviour. This is a recurrent component of many theories, including the Health Belief Model (perceived benefits; Rosenstock, 1974) and the Theory of Planned Behaviour (behavioural beliefs; Ajzen, 1991). The teachable moment heuristic framework suggests that events that cause people to appraise the positive and negative outcomes of a behaviour may prompt behaviour change.

Generally, there has been limited research exploring outcome expectancies within the context of cancer screening programmes. In addition, positive outcome expectancies have not been tested in relation to cancer-related health behaviours other than smoking. The perceived benefits of quitting smoking as a predictor of smoking cessation have been explored within lung screening
settings (Ostroff et al., 2001). More than half of people who recognised the benefits of quitting smoking (54%) reported quitting or reducing their smoking at follow-up, compared with 22% of people who did not recognise the benefits of quitting (OR 4.02, 95% CI 1.25-12.94). However, a study by Park and colleagues (2013) found that perceived benefits of quitting smoking did not change for current smokers following lung screening. A marginal change in the perceived benefits of quitting smoking was observed among former smokers following lung screening.

1.3.4 Self-concept

This component of the Teachable Moment Heuristic Framework relates to how an individual perceives a behaviour as part of their identity. McBride and colleagues (2003) suggest that teachable moments prompt changes to self-concept. Most commonly, self-concept has only been measured in relation to smoking behaviour, and remains untested for other cancer-related health behaviours. Smoking self-identity has been explored as a correlate of smoking behaviour change (Shadel & Mermelstein, 1996). Two coexisting constructs, smoker self-concept and abstainer self-concept, are predictive of smoking status. Greater abstainer self-concept and lower smoker self-concept were associated with abstinence three months after enrolment in a smoking treatment programme. The relation between non-smoker identity and long-term abstinence was also explored in a population-based survey of English adults (Tombor, Shahab, Brown, Notley, & West, 2015). The sample included 574 recent quitters, defined as people who had quit smoking within the last year. The majority of recent quitters reported a non-smoker identity at baseline (80.3%). Three-month (n=179) follow-up data suggest that non-smoker identity is associated with abstinence (OR 2.64, 95% CI 1.09-6.42). However, among 163 people followed up at 6 months, this effect had diminished (OR 2.05, 95% CI 0.83-5.04).

One study has explored health-related self-identity as a predictor of engagement in a bowel cancer prevention intervention (McBride et al., 2008). In contrast to measures of smoking self-concept, the authors measured how people rated their general health (excellent, good, fair, poor). The measure of health-related self-identity was not predictive of intervention engagement. However, this measure may not accurately reflect the self-concept construct. Thus, the conclusions that can be drawn from this study about self-concept and the teachable moment at
cancer screening are limited. The intervention examined a range of behavioural cancer risk factors, including smoking, fruit and vegetable consumption, red meat, alcohol consumption and physical activity. The use of measures which attempt to understand people’s self-concept in relation to each of these risk behaviours may have been more appropriate. Therefore, the authors highlighted the need to include alternative measures of self-identity in future research.

1.3.5 Social role

This component of the Teachable Moment Heuristic is related to how a behaviour fits within a wider social structure. The influence of social role is acknowledged in many theories of behaviour, including the COM-B framework (Michie, van Stralen, & West, 2011) and Social Cognitive Theory (Bandura, 1998). McBride and colleagues list two social perceptions which may drive behaviour: people’s perceived role responsibilities, and perceptions of important others’ judgements about a behaviour (McBride et al., 2003). Teachable moments are theorised to change people’s perceptions of the social role of a behaviour. To my knowledge, studies exploring cancer screening as a teachable moment have not yet included measures of social role as explanatory variables. Therefore, it is not possible to draw any conclusions about social role and the teachable moment at cancer screening.

1.3.6 Alternative models of the teachable moment

An alternative framework for understanding the teachable moment was proposed by Lawson and Flocke (2009). In contrast to the Teachable Moment Heuristic Framework, Lawson and Flocke (2009) propose that a teachable moment can be co-created through interactions, such as those between patients and health care professionals. The authors discuss the importance of understanding how teachable moments are created for both parties. This model is more in line with policy to Make Every Contact Count (MECC; Public Health England, 2016b), by recognising the role of health care professionals initiating conversations about behaviour change. The model proposes an expansion of the Health Belief Model (Rosenstock, 1974), taking into account both patient and clinician’s perceived threat and cues to action. Lawson and Flocke (2009) also recognise the importance of the wider systems that the patient and clinicians sit within, including the healthcare system. The omission of the wider healthcare system is a limitation of the McBride...
et al. Teachable Moment Heuristic Framework (2009), which considers only psychological factors in the creation of the teachable moment and only on the side of the patient.

Observations of patient-clinician interactions have identified three components involved in creating a teachable moment (Cohen, Clark, Lawson, Casucci, & Flocke, 2011). A patient's health-related concern was linked to a behavioural risk factor by the clinician, the clinician attempted to motivate the patient to change their behaviour, and the patient responded positively with a commitment to change. One study used these criteria to code when a teachable moment had occurred using observational recordings of patient-clinician interactions and then linked this to patient recall of advice and health behaviour (Flocke et al., 2014). When a teachable moment was initiated, 85% of patients recalled receiving advice, compared with other types of interaction (49-74%). However, no difference in behaviour change was observed in interactions coded as teachable moments, compared with other interactions.

More recently, the COM-B model of behaviour has been used to understand the perinatal period as a potential teachable moment (Olander, Darwin, Atkinson, Smith, & Gardner, 2015). The COM-B model of behaviour sits within the behaviour change wheel; a synthesis of 19 frameworks of behaviour change (Michie et al., 2011). According to the COM-B framework, in order for a behaviour to occur, an individual must have the required capability (physical/psychological), opportunity (social/physical) and motivation (automatic/reflective). The opinion piece written by Olander and colleagues (2015) suggests that the explorations of the teachable moment should go beyond motivation, to understand whether changes in capability, opportunity and motivation prompt receptivity to behaviour change interventions. However, this relatively new framework has not yet been tested to understand the mechanisms involved in the teachable moment or suggested as a basis for the creation of teachable moments outside of perinatal behaviour change.

Despite potential theoretical frameworks and models for understanding the teachable moment proposed by McBride and colleagues (2003), Lawson and Flocke (2009) and Olander and Colleagues (2015), there is still no clear consensus on what a teachable moment is and how it manifests. In view of the most common conceptualisations of the teachable moment, section 1.4
will consider the evidence relating to cancer screening as a prompt for spontaneous behaviour change. Section 1.5 will consider the evidence relating to cancer screening as an opportunity to provide cancer prevention advice and interventions.

1.4 Cancer screening as a prompt for spontaneous behaviour change

Research has considered whether cancer screening can prompt spontaneous changes to health behaviours. The majority of research within this field has been conducted within lung screening settings. One reason for this is that lung cancer screening is not yet widely implemented, and there are fewer barriers to conducting research within trial settings compared with existing screening programmes. Two reviews of studies measuring smoking cessation at lung cancer screening have been published (Slatore, Baumann, Pappas, & Humphrey, 2014; van der Aalst, van Klaveren, & de Koning, 2010). The most recent of these reviews identified eight studies exploring the impact of LDCT screening on smoking behaviour, including two RCTs. The review authors reported that these studies, alongside six observational studies, did not indicate a positive effect of lung screening participation on smoking behaviours. One year after randomisation, rates of smoking cessation were 11% in the screened group of the Danish Lung Cancer Screening Trial, compared with 10% in the control group (Ashraf et al., 2009). Similarly, in the Dutch-Belgian Lung Cancer Screening trial, 13% of the LDCT group had quit smoking 2.2 years after randomisation, compared with 15% of the control group (van der Aalst, van den Bergh, Willemsen, de Koning, & van Klaveren, 2010).

An earlier review looked more broadly at the effects of screening on lifestyle (van der Aalst, van Klaveren, et al., 2010). Studies relating to lung and colorectal cancer screening were identified. However, no studies looking at behaviour change following breast or cervical screening were found. The review was unable to make any firm conclusions about the positive or negative effects of screening, due to the limited number of studies exploring cancer screening as a teachable moment. This review included literature published between 2000 and 2010. There is, therefore, a case for conducting an updated review of behaviour change in the context of a range of cancer screening programmes.
There has been limited research conducted in the UK exploring cancer screening as a teachable moment. One study has reported smoking cessation outcomes within a randomised controlled lung screening trial (Brain et al., 2017). Data from the UK Lung Cancer Screening Trial (UKLS) were used to determine whether rates of smoking cessation were higher among participants randomised to receive LDCT lung screening, compared with a non-screened control group. In intention to treat analyses, the LDCT group had greater rates of cessation, compared with the control group at two-week follow-up (10% vs 5%) and two-year follow-up (15% vs 10%). In complete case analyses, 14% of the screened group had quit at two-week follow-up, compared with 7% of the control group. At the two-year follow-up, cessation rates were 24% and 21% for the screened and control groups respectively. These results suggest that lung screening participation might have a positive impact on smoking behaviour, particularly in the short term. It is important to note that both the intervention and control group quit smoking at a greater rate than would be expected in the general population, suggesting that trial participation may prompt smoking behaviour change. However, both groups were offered smoking cessation advice leaflets and were given a list of local stop smoking services.

One issue with much of the literature in this area is the absence of a control group or comparator groups to determine whether behaviour change is as a result of screening participation. For example, one study explored behaviour change following FS (Miles, Wardle, McCaffery, Williamson, & Atkin, 2003). Among the 3,535 participants surveyed, rates of smoking decreased, and rates of fruit and vegetable intake and physical activity increased 3-months after FS participation. Participants were also asked to rate how important they found a range of cancer-preventive behaviours. Rating of the importance of both fruit consumption and physical activity increased following screening. It is unknown whether these changes are attributable to FS participation or other unknown factors. There is, therefore, a need for more research which compares behaviour change in screening participants with suitable control or comparator groups across a range of screening modalities.

While the research in this field has predominantly sought to determine whether cancer screening participation positively affects health behaviour, some literature has raised concerns about the
potential for screening to negatively impact behaviour. In 1997, an editorial titled ‘Screening could seriously damage your health’ was published in the British Medical Journal (Stewart-Brown & Farmer, 1997). The editorial called for the social and psychological consequences of screening participation to be taken into consideration when weighing up the harms and benefits of participation. One of the psychological harms included in the editorial was the possibility of a health certificate effect. The health certificate effect is proposed to manifest in response to negative screening results. It was hypothesised that negative screening results might reinforce cancer risk behaviours by providing over-reassurance, attenuating motivation for behaviour change.

One of the first studies to explore the health certificate effect assessed whether behaviour change differed between people receiving positive and negative cardiovascular screening results (Tymstra & Bieleman, 1987). The screening was offered to 428 men, of whom 267 participated. Participants and non-participants were invited to complete a follow-up questionnaire two months later. Around half of the participants had a positive screening result, determined by meeting at least one cardiovascular risk related criteria such as smoking or hypertension. Around half of participants who received an all-clear result interpreted their result as proof that they did not need to change their health behaviour. However, it is unclear whether this result is replicated within other screening programmes. One RCT of FS screening in Norway suggested positive health behaviour change may be more likely to occur in control group participants (Larsen, Grotmol, Almendingen, & Hoff, 2007). Both the screened and control groups made positive changes to a number of lifestyle indicators over time. However, there was evidence that behaviour change was inhibited within the screened group. For example, those who participated in FS did not display as marked an increase in physical activity compared with the control group. However, longer-term follow-up of the same sample found that differences in rates of change between groups had diminished eleven years after the screening (Berstad et al., 2015).

A recent systematic review assessed whether the receipt of negative screening results causes over-reassurance (Cooper, Harvie, & French, 2017). The review included studies that report levels of behaviour change in health-protective behaviours among participants receiving positive
and negative screening results. The nine RCTs included in the review provided limited evidence to support this supposition, leading the authors to conclude that over-reassurance should not be considered a harm of screening participation. However, of the included studies, just three were conducted within the context of cancer screening programmes. This suggests that more research is needed to fully understand the impact of cancer screening results on health behaviour.

1.4.1 Summary

As indicated in the literature summarised above, unprompted behaviour change following cancer screening is not clear or guaranteed. Results of studies have reported both enhanced and inhibited behaviour change among screening participants, as well as null results. Literature identified in reviews of the behaviour change following screening highlights that the vast majority of research has been conducted within lung screening settings. There is, therefore, a need to conduct studies exploring spontaneous change within existing NHS screening programmes. As well as conducting original research in a range of screening settings, it is important to synthesise studies exploring cancer screening as a prompt for spontaneous behaviour change. As the most recent review of literature across multiple screening programmes was published in 2010, it is possible that additional research within relevant settings has been conducted.

An updated and comprehensive systematic review of literature exploring behaviour change for a number of cancer risk factors, across a number of screening programmes (breast, bowel, cervical and lung) is presented in Chapter 3. An exploration of multiple health behaviour change following FOBT participation within an English longitudinal study, which compares screening participants with screening non-participants, is presented in Chapter 4.

1.5 Cancer screening as an opportunity for interventions to support behaviour change

Irrespective of whether participation in cancer screening prompts spontaneous changes to health behaviours, there is increasing interest in whether cancer screening may provide opportunities to support behaviour change and reinforce messages about behavioural cancer prevention (Anderson, Mackison, Boath, & Steele, 2013). The provision of lifestyle advice alongside cancer
screening is consistent with MECC policy (Public Health England, 2016b). MECC relies on the
delivery of brief interventions and very brief interventions, dependent on the context (National
Institute for Health and Care Excellence, 2014). Very brief interventions take typically 30 seconds
to a couple of minutes and involve alerting people to risk factors, providing encouragement, or
signposting people to resources and sources of support. Brief interventions build on the
techniques used in very brief interventions by also including an element of discussion. Brief
interventions may also include referrals to services, which can support behaviour change (such
as stop smoking services) and may include follow-up conversations with service users. This
approach has successfully been used in primary care to promote weight management
programmes for people who are affected by overweight (Aveyard et al., 2016), and to provide
brief alcohol consumption advice (O'Donnell et al., 2014).

Cancer screening may provide an ideal opportunity to implement MECC. However, behaviour
change interventions are not currently included in cancer screening implementation guidelines
(Public Health England, 2016b). There is little evidence that behavioural advice is routinely offered
alongside existing screening programmes (Anderson et al., 2013), and there is inconsistency
regarding whether information about behavioural cancer risk factors is included in leaflets inviting
people to participate in cancer screening. For example, the leaflet provided to help women make
an informed decision about participating in breast screening lists age as a risk factor but does not
mention behavioural risk factors (NHS, 2019a). Conversely, the leaflets given to those eligible to
attend bowel screening programmes list a range of potential bowel cancer risk factors including
physical activity, diet, alcohol consumption and smoking (Public Health England, 2018). While
some NHS screening leaflets mention behavioural cancer risk factors, most do not provide
specific advice about behaviour change or signposting patients to support services.

The UK NSC does not currently recommend lung cancer screening. However, recommendations
from countries and organisations that recommend the implementation of lung cancer screening
also include guidance on the delivery of smoking cessation advice in conjunction. The recent
European Position Statement on Lung Screening recommends that smoking cessation advice
should be offered to all smokers participating in lung screening programmes (Oudkerk et al.,
Similarly, following the US Preventive Services Task Force recommendation that an LDCT lung screening programme should be implemented within the United States, a further recommendation was made that smokers participating in lung screening should be encouraged to quit (Fucito et al., 2016).

A summary of literature assessing breast, bowel, cervical and lung cancer screening settings as opportunities to support behaviour change is presented below.

1.5.1 Breast cancer screening as an opportunity to deliver healthy lifestyle advice

Research exploring breast cancer screening as a teachable moment has predominantly assessed the feasibility and acceptability of delivering advice within breast screening clinics. In 2007, 413 women attending the NHS breast cancer screening programme in North and East Yorkshire were surveyed to determine levels of interest in diet and exercise advice (Fisher, Dowding, Pickett, & Fylan, 2007). Most of the sample reported some interest in receiving diet and exercise advice alongside breast cancer screening (85.4%), with around a quarter of the sample being very interested in advice. The authors explored whether interest was different according to weight status. A greater number of participants who were overweight showed some interest in advice (93.4%), compared with participants who were not overweight (80.3%) and women in the obese category (85.5%). Fisher and colleagues (2007) also considered whether the provision of lifestyle advice would deter people from attending future breast screening appointments. Overall, 0.7% of the sample reported that they would be less likely to attend, and 8.5% of the sample reported they would be more likely to attend. The study provides reassurance about the acceptability of lifestyle advice at breast screening. However, the study was conducted within two clinics in North and East Yorkshire more than 10 years ago. This is problematic as it calls into question the generalisability of results to the whole English population. Therefore, an updated and more representative study would be beneficial.

More recently, a mixed-method study set within breast clinics explored the acceptability of addressing alcohol consumption as a cancer risk factor (Sinclair et al., 2019). The study included the views of 102 breast screening attendees, 103 women attending symptomatic breast screening clinics, and 33 healthcare professionals. None of the women reported that the provision of cancer
prevention information would deter future participation, and around 30% of the sample thought the provision of advice would make them more likely to attend. However, results were aggregated across women who were attending breast screening and the symptomatic clinic. These populations may differ in their experience of the screening process. A number of barriers to the delivery of lifestyle advice were identified, including time, resources and levels of anxiety. Findings of the qualitative component of the research also reflected women’s limited knowledge of alcohol as a risk factor for breast cancer. Both attendees and health care professionals raised the need for consistent, evidence-based information about alcohol consumption. Health care professionals raised concerns about the impact of lifestyle advice on attendance; however, this was not a concern for attendees. Health care professionals did not necessarily view the delivery of lifestyle advice as part of their role and were concerned about causing feelings of guilt and blame if they were to address alcohol consumption within breast screening and symptomatic clinics.

There is ongoing work to understand whether interventions delivered in breast screening settings are effective at modifying behavioural cancer risk factors. One example is the ActWELL trial, currently being evaluated in Scotland (Anderson et al., 2018). As part of this RCT, women who participate in breast cancer screening will be provided information about the trial. Women who agree to participate will be randomised to receive a 12-month lifestyle programme, or usual care (a leaflet). The focus of the intervention is weight management, with participants receiving personalised dietary and physical activity information. The intervention is based on the COM-B model of behaviour change (Michie et al., 2011). Women in the intervention group will receive two face-to-face meetings and nine telephone appointments over the study period, delivered by trained Breast Cancer Now volunteers. The ActWELL trial has been shown to be feasible based on recruitment and retention rates (Anderson, Macleod, et al., 2014). Of the women approached about the intervention, 43% were interested in participating; of whom 56% were willing to participate. This suggests that further research would benefit from understanding what makes an intervention acceptable at screening, and for whom. Preliminary analyses of the feasibility trial suggest the intervention may also be effective at promoting weight loss, with 2.04kg weight loss at 3 months in the intervention group, compared with 0.04kg weight loss in the control group. While the early results of the trial are promising, it is not known whether less intensive
interventions would be feasible, acceptable and effective within breast screening settings. Furthermore, the primary endpoint of the study is weight loss. There is epidemiological evidence linking weight to cancer; however, it is not known whether an intervention such as ActWELL can reduce cancer risk.

An example of a less intensive intervention is a lifestyle magazine used to deliver behavioural cancer prevention advice (Macleod & Anderson, 2018). The magazine was evaluated in Scottish breast screening clinics for a two-month period. Uptake of the magazine was 95% when women were actively offered the magazine, but only 20% when the magazine was self-service. An evaluation of the magazine was conducted, with a response rate of less than 20% of women who received the magazine. Despite the low response rate to the evaluation, 95% of women felt their knowledge about the link between lifestyle and cancer had increased. Furthermore, 94% of women reported wanting to make changes to their lifestyle. Interviews with clinic staff highlighted that the intervention was not burdensome to implement. This promising preliminary work suggests minimal interventions may be acceptable within breast screening. However, the study did not assess any behavioural outcomes. While it is encouraging that most women reported wanting to make changes to health behaviours, it is important to consider the potential intention-behaviour gap. For example, it is estimated that the intention-behaviour gap may be as high as 48% for physical activity (Rhodes & de Bruijn, 2013). Therefore, actual behaviour change attempts are likely to be considerably lower than 94% following this minimally intensive intervention.

1.5.2 Bowel cancer screening as an opportunity to deliver healthy lifestyle advice

A recent consultation of 71 patients, clinicians and researchers identified a number of research priorities to improve colorectal cancer prevention efforts and cancer outcomes (Lawler et al., 2018). The report highlighted the need to integrate dietary, lifestyle and chemoprevention interventions into settings such as bowel cancer screening programmes.

Research to date has included tailored interventions delivered alongside FS (Baker & Wardle, 2002; Knudsen et al., 2018; Robb, Power, Kralj-Hans, Atkin, & Wardle, 2010). Two studies showed positive effects on fruit and vegetable consumption (Baker & Wardle, 2002; Robb et al., 2010). In a brief intervention delivered alongside the UK Flexible Sigmoidoscopy trial (UK FS;
n=742), participants in the intervention group were given tailored feedback on fruit and vegetable consumption (Baker & Wardle, 2002). At six week follow-up, participants in the intervention group had increased their fruit and vegetable intake by 1.06 portions per day, compared with an increase of 0.26 portions in the control group. Similarly, the study by Robb et al., (2010) compared a standard advice leaflet, with a condition receiving additional tailored advice, and a control group. At baseline, the proportion of people meeting fruit and vegetable consumption was similar across the standard intervention (36.8%), tailored intervention (36.4%), and control groups (37.7%). At six-month follow-up, fruit and vegetable consumption had increased only in the tailored intervention group (45.1%). No effect was found for physical activity or alcohol consumption. This suggests that some health behaviours may be more amenable to change than others.

Tailored advice was also reported to be minimally effective in a Norwegian FS screening programme (Knudsen et al., 2018). One group of participants received tailored lifestyle feedback, and another received a leaflet with details about lifestyle and cancer prevention. A control group received no information about lifestyle and cancer. The authors assessed the number of cancer preventive behaviours that the 1,054 FS participants were engaged in, including abstaining from smoking, physical activity, low alcohol consumption, and consumption of fruits and vegetables and red and processed meat. At one-year follow-up, there was a modest increase in the number of cancer-preventive behaviours within the tailored advice group (baseline = 2.0, follow-up = 2.1), but not within the leaflet (baseline = 2.1, follow-up = 2.1) or control groups (baseline = 2.0, follow-up = 2.0). However, this effect was modest. A key limitation of these studies is the use of self-report measures of health behaviours.

A number of lifestyle interventions delivered at bowel screening have targeted patients with screen-detected adenomas, rather than people with negative screening results. The BeWEL trial was an intervention, which targeted body weight and physical activity among overweight or obese adults (Anderson, Craigie, et al., 2014). The trial recruited people who had undergone colonoscopy following FOBT screening, who had colorectal adenomas detected. Participants were randomised to receive the lifestyle intervention, or to a control group. The 12-month intervention included three one-on-one visits followed by nine 15-minute telephone consultations.
At 12-month follow-up, the participants in the intervention group had lost on average 3.50kg, compared with 0.78kg in control group participants. One-third of intervention group participants attained clinically significant weight loss (>5% bodyweight reduction). Further analyses of the BeWEL trial have attempted to determine why the intervention yielded greater results for some participants than others (Stead et al., 2015). Those who achieved the greatest weight loss were less likely to have issues relating to physical and emotional health and were more likely to believe that their current diet was harmful. A less intensive intervention using a similar population of people with colorectal adenomas was evaluated in the Bowel Health to Better Health programme (Caswell, Anderson, & Steele, 2009). The three-month intervention involved a one-on-one assessment followed three personalised mailings, focusing on dietary factors and physical activity. Increases in fibre intake were greater among the intervention group, compared with a control group. The findings of the BeWEL trial and the Bowel Health to Better Health programme suggest that interventions may be feasible and effective among patients with abnormal screening results. However, it is important to note that the experiences of patients with adenomas are likely to differ from participants with negative screening results. Therefore, interventions integrated into bowel screening programmes must consider the differing needs of these groups.

1.5.3 Cervical cancer screening as an opportunity to deliver healthy lifestyle advice

Interventions conducted within the context of cervical cancer screening have targeted smoking cessation. A recent qualitative study recruited 15 Dutch smokers who had participated in cervical screening (Mansour, Crone, van Weert, Chavannes, & van Asselt, 2019). Most participants were unaware of the link between smoking and cervical cancer and therefore felt that an explanation of why smoking would be addressed at cervical screening was necessary. Participants stated that they expect conversations about their smoking with health professionals, and thought that these conversations were generally acceptable within primary care. However, there were differences in whether people felt it was appropriate to have this conversation at cervical screening. Some people expressed concern about feelings of stigma if cessation advice was delivered alongside cervical screening. It is important to understand the individual differences in responses to lifestyle advice at screening.
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The effectiveness of a smoking cessation intervention following cervical screening was evaluated by McBride et al. (1999). Smokers who had participated in cervical screening were randomised to receive a self-help intervention (n=288), or to a usual care control group (n=292). Two weeks after taking part in cervical screening, the intervention group received a smoking cessation kit (smoking cessation guide and information about smoking and cervical cancer). The intervention group were also offered three follow-up phone calls. At six-month follow-up, there were no differences in seven-day abstinence (10.9% vs 10.5%) or 24-hour quit attempts (21.1% vs 30.6%) between the intervention and control groups. While the intervention was not effective at increasing smoking cessation, results regarding receptivity to advice at cervical screening are encouraging. Of the women allocated to the intervention group, 81% accepted at least one intervention call, and 65% read all or most of the smoking cessation information. This suggests that while there is a clear need to identify effective intervention strategies, women are open to this advice, and cancer screening could be an opportunity to provide support.

Interventions targeting smoking cessation at cervical screening have also been conducted in English populations. One intervention evaluated two leaflets informing smokers of the link between smoking and cervical cancer delivered within a cervical screening programme (Hall, Bishop, & Marteau, 2003). The leaflets included information about the dangers of smoking, the dangers of cervical cancer, the benefits of quitting smoking, and a message aiming to increase smoking self-efficacy. One of the leaflets also included a detailed explanation of the link between smoking and cervical cancer. Questionnaires were completed by 172 women aged 20-64. Women who received the brief questionnaire were more likely to report being ready to quit within the next six months, compared with women who received the questionnaire with an explanation of the link between smoking and cervical cancer, and with women who were not sent a leaflet. This is inconsistent with qualitative research suggesting that women would like an explanation of the link between smoking and cervical cancer (Mansour et al., 2019). The research by Hall and colleagues (2003) did not measure change in actual smoking rates. The authors also did not explore the acceptability of the leaflets. However, 5% of the sample were excluded because they did not read the leaflet. This suggests that a small proportion of women may not be open to
smoking cessation advice at cervical screening. Future research should explore the acceptability, and determinants of acceptability of advice in this setting.

An RCT evaluated the feasibility, acceptability and potential effectiveness of brief smoking cessation advice at cervical screening (Hall, Reid, Ukoumunne, Weinman, & Marteau, 2007). Smokers attending cervical cancer screening were randomised to an intervention (n=121) or control group (n=121). The intervention participants received brief verbal smoking cessation advice from their practice nurse and an information pack containing further information about smoking and cervical cancer and smoking cessation recourses. Loss to follow-up was 26% in the intervention group and 32% in the control arm. Including the intervention in cervical screening appointments added on average 5 minutes to the screening appointment. Women in the intervention group scored higher on measures of intention to quit smoking at two and ten-week follow-up. The difference between smoking cessation in the two arms was not statistically significant (12% vs 5%). However, this could be because the study was not powered to detect that magnitude of difference in smoking cessation. While not statistically significant within this small study, an effect of this magnitude across the proportion of smokers attending cervical screening annual could be clinically significant. The authors conclude that the intervention was feasible and acceptable.

Overall, studies have yet to confirm whether smoking cessation advice delivered alongside cervical screening is feasible and effective. Furthermore, these studies highlight the importance of delivering advice in a way that is acceptable, and that does not result in feelings of stigma. Future research must focus on screening participants’ preferences for how lifestyle advice is delivered alongside cervical screening. In addition, it is not known whether cervical screening can provide a teachable moment for other cancer risk factors, such as diet, physical activity, or alcohol consumption.

1.5.4 Lung cancer screening as an opportunity to deliver healthy lifestyle advice
As discussed previously, it has been recommended that smoking cessation advice be integrated into lung screening programmes (Fucito et al., 2016; Oudkerk et al., 2017). A recent systematic review synthesised the results of smoking cessation interventions delivered alongside LDCT lung
screening (Iaccarino, Duran, Slatore, Wiener, & Kathuria, 2019). The review included nine studies, including five RCTs. Most RCTs found no differences in smoking cessation at follow-up between intervention and control arms (Clark et al., 2004; Ferketich et al., 2012; Marshall et al., 2016; van der Aalst, de Koning, van den Bergh, Willemsen, & van Klaveren, 2012). Most of the RCTs identified in the review were pilot trials. One pilot RCT reported that telephone-based smoking cessation advice is likely to be feasible and effective (Taylor et al., 2017). Biochemically verified quit rates were 17.4% in the intervention group, compared with 4.3% in the usual care group. The review also identified 11 studies underway, exploring smoking cessation interventions within the context of LDCT. This highlights a growing interest in research exploring lung screening as an opportunity for risk reduction. It is important to note that research has not yet considered lung cancer screening as an opportunity to provide advice about other cancer-related health behaviours.

Acceptability of smoking cessation advice at lung screening has been explored in qualitative research. Interviews of 21 physicians and 28 smokers were used to understand views about the integration of smoking cessation and lung screening (Kathuria et al., 2018). Physicians reported resource-related barriers to integrating services and concern that patients may be too overwhelmed by the screening process to be receptive to discussions about smoking cessation. Participants who had undergone lung screening reported a lack of smoking cessation support at lung screening. Furthermore, some participants felt that failure to provide smoking cessation advice to patients with normal results could reinforce smoking behaviour among attendees.

One study reports that just over half of lung screening sites in the United States routinely provide smoking cessation counselling to attendees or refer attendees to smoking cessation services such as a quitline (Ostroff, Copeland, Li, Shelley, & Henschke, 2016). There are many methodological issues regarding the development of smoking cessation interventions embedded in lung screening programmes. The Smoking Cessation within the Context of Lung Cancer Screening (SCALE) Collaboration is a collective of eight ongoing clinical trials hoping to address these issues (Joseph et al., 2018). The SCALE collaboration estimate that more than half of lung screening participants will be current smokers, due to the risk-based eligibility criteria for lung
screening programmes. Furthermore, the smokers included in lung screening programmes are likely to be highly nicotine dependent based on the high pack-year histories also included in many criteria for determining lung screening eligibility. This means that smoking cessation treatments offered to the general population may not be suited to this high-risk group. The SCALE collaboration describe a ‘critical gap’ in our understanding of how to implement smoking cessation within lung screening.

One key component of this knowledge gap is how best to deliver smoking cessation support based on a person’s lung screening result. Around a quarter of people attending lung screening will receive an abnormal result, requiring further investigations. The experiences of people receiving normal and abnormal results are likely to differ, as well as their needs and preferences for smoking cessation support. It is not known whether advice is equally acceptable among people who receive normal and abnormal results.

1.5.5 Summary

There is increasing evidence linking a number of health behaviours and the development of cancer, and the potential reach of advice delivered alongside cancer screening programmes is substantial. There remain a number of key unanswered issues. Screening participants’ preferences for lifestyle advice are poorly understood, as is the potential impact of advice on screening uptake. Understanding who is open to advice at cancer screening, and why, is crucial for the development of interventions. To date, the scope of interventions has been limited in terms of the behaviours addressed. For example, studies conducted in lung and cervical screening settings have only targeted smoking. The acceptability of a range of topics of lifestyle advice alongside breast, bowel and cervical screening (Chapter 5) and lung screening (Chapter 6) are explored within this thesis, as well as sociodemographic, psychological and behavioural determinants of interest in advice (Chapters 5 and 6), and individual differences in screening participants’ receptivity to advice at cancer screening (Chapter 7).

1.6 Conclusion

There is convincing evidence linking a number of lifestyle-related behavioural risk factors to several highly prevalent cancers. Furthermore, data on the health behaviours of English adults
suggests there is significant scope for the modification of cancer risk factors. Cancer screening could be a teachable moment for cancer risk factor reduction. However, multiple conceptualisations of what constitutes a teachable moment have resulted in two fields of research: cancer screening as a prompt for spontaneous behaviour change, and cancer screening as an opportunity to support behaviour change through the delivery of advice and interventions. This thesis intends to fill a number of key research gaps by exploring whether cancer screening participation prompts spontaneous health behaviour change, and investigating cancer screening as an opportunity to deliver cancer prevention advice.
Chapter 2. Aims

This thesis aims to build on our understanding of cancer screening as a teachable moment for risk reduction behaviour by addressing some of the research gaps outlined in the introductory chapter. Three primary aims, with corresponding objectives, are outlined below:

Aim 1. To explore whether participation in cancer screening programmes prompts spontaneous changes to health behaviours

First objective. To synthesise and evaluate previous literature investigating whether spontaneous behaviour change occurs following breast, bowel, cervical and lung screening (Chapter 3).

Second objective. To investigate whether participation in FOBT screening prompts spontaneous health behaviour change using prospective cohort data (Chapter 4).

Aim 2. To gauge interest in lifestyle advice at cancer screening

First objective. To determine levels of willingness to receive information about cancer risk factors within existing cancer screening programmes (breast, bowel and cervical screening programmes), and determinants of willingness to receive advice (Chapter 5).

Second objective. To determine preferences for the content and timing of lifestyle advice delivered within existing cancer screening programmes (breast, bowel and cervical screening programmes (Chapter 5).

Third objective. To determine levels of willingness to receive information about cancer risk factors at lung cancer screening, and determinants of willingness to receive advice (Chapter 6).

Fourth objective. To determine preferences for the content and timing of lifestyle advice delivered at lung cancer screening (Chapter 6).
Fifth objective. To gain an in-depth understanding of the screening participants’ preferences for lifestyle advice delivered alongside NHS breast, bowel and cervical screening programmes (Chapter 7).

Aim 3. To understand individual differences in screening participants’ receptivity to advice at cancer screening

First objective. To develop an in-depth understanding individual differences in recent screening participants’ receptivity to advice at cancer screening (Chapter 7)
Chapter 3. Spontaneous health behaviour change following breast, bowel, cervical and lung cancer screening: a systematic review

3.1 Introduction

As presented in Chapter 1, one conceptualisation of the teachable moment is that of a prompt for spontaneous behaviour change (Lawson & Flocke, 2009). The McBride et al. (2003) Teachable Moment Heuristic Framework attempts to map the potential mechanisms of this proposed phenomenon. The authors used the example of smoking cessation following a range of health events, such as hospitalisation or diagnosis of disease, as a basis for the model. However, in 2003, when the model was published, there was limited research exploring whether this effect manifests within the context of cancer screening. A systematic review published in the same year aimed to explore the impact of cholesterol, breast and cervical cancer screening on health beliefs and behaviours (Bankhead et al., 2003). At the time of the review, these were the only screening programmes implemented within England. No prospective research looking at the impact of breast and cervical screening participation on these health behaviours was identified. A recommendation of the review was to assess a wide range of health behaviours before and after screening, to determine whether changes in health behaviours could be attributed to participation.

The first reviews to identify research on the impact of cancer screening participation on health behaviour were published in 2010 and 2011 (Deutekom et al., 2011; van der Aalst, van Klaveren, et al., 2010). One review identified studies conducted within lung and colorectal cancer screening settings (van der Aalst, van Klaveren, et al., 2010). The other review, which was limited to RCTs and did not include studies conducted alongside lung screening, identified a single study conducted within a bowel screening setting (Deutekom et al., 2011). Neither review provided support for cancer screening as a teachable moment for health behaviour change. More recently, a review sought to identify studies assessing smoking behaviour change following low-dose computed tomography (LDCT) lung screening (Slatore et al., 2014). Eight papers were identified from two RCTs and three cohort studies. In line with previous reviews, the review by Slatore and
colleagues (2014) did not support the suggestion that participating in LDCT lung screening influences rates of smoking.

All previous reviews have highlighted the need for additional research exploring the impact of screening participation on health behaviour change. There have been several important changes to the implementation of a range of screening programmes since these reviews were published, such as the recommendation for FS in England and lung screening in the USA (U.S. Preventive Services Task Force, 2016; UK National Screening Committee, 2019). Therefore, it is likely that additional research has been conducted within a range of screening modalities since the existing reviews were published.

The literature in this area is anticipated to be highly heterogeneous. This is due to the range of screening programmes assessed (breast, bowel, cervical and lung screening), and differences in organisation and delivery of the programmes between countries. Screening can either be organised, opportunistic, or a combination of the two (Miles, Cockburn, Smith, & Wardle, 2004). Another key difference between screening programmes, and therefore literature in this area, is the eligible populations. For example, breast, bowel and cervical screening programmes are available to anyone who falls within a given age range (e.g. females age 25-64; cervical screening in England). However, lung screening programmes typically assess individuals’ lung cancer risk (Gray, Teare, Stevens, & Archer, 2016), and invite only participants with an increased lung cancer risk profile. There are also differences in the screening modality offered. For example, within bowel screening, programmes may utilise FOBT, FIT, FS or colonoscopy. Furthermore, the way in which health behaviours are measured between studies is likely to be another source of heterogeneity.

Although several reviews have been published exploring behaviour change following screening participation, many are outdated (Deutekom et al., 2011; van der Aalst, van Klaveren, et al., 2010). Other reviews do not provide a comprehensive overview of the literature relating to the review questions outlined below, by focusing on single screening modalities (Slatore et al., 2014), or by restricting the study designs included in the review (Deutekom et al., 2011). Therefore, an
updated review, spanning a range of health behaviours and screening programmes is required to understand the impact of screening participation on cancer risk-related behaviours.

3.1.1 Review questions

In line with the first aim of this thesis, this review assessed the available literature exploring spontaneous health behaviour change following participation in cancer screening. Two review questions are addressed in this chapter:

1. Does participation in breast, bowel, cervical or lung cancer screening lead to spontaneous changes in cancer-related health behaviours?

2. If spontaneous behaviour change does occur, is it in a positive or negative direction?

3.2 Methods

3.2.1 Protocol and registration

A protocol for this systematic review was registered on the PROSPERO international prospective register of systematic reviews (PROSPERO 2016:CRD42016036075).

3.2.2 Criteria for considering studies for review

3.2.2.1 Types of studies

Randomised controlled trials and observational studies were eligible for review, provided outcome measures were measured prospectively.

3.2.2.2 Types of participants

Asymptomatic adults eligible to attend screening for breast, bowel, cervical and lung cancers. Population eligibility differs according to the screening modality and country in which the research took place. Studies were excluded from the review if their samples included people under the age of 18, participants undergoing diagnostic testing for cancer, or if participants were selected based on being at an increased genetic risk of the cancer for which the individual is undergoing
screening. Populations of the included studies differ according to screening modality. Breast, bowel and cervical cancer screening programmes invite all members of a population to participate, providing they fall within the specified age range. Breast and cervical screening programmes invite only female members of the population. In contrast, risk-based inclusion criteria are used for lung screening trials and programmes. Typically, lung screening invitees are invited on the basis of age and lung cancer risk factors, such as smoking history (U.S. Preventive Services Task Force, 2016). This results in an invited population that does not represent the general population.

3.2.2.3 Types of exposure

Studies that took place within the context of breast, bowel, cervical or lung cancer screening were eligible for review. To account for differences in cancer screening practices between countries, eligible studies could report data from opportunistic or organised screening programmes. Studies reporting trials of new screening programmes were also eligible for review.

Unique to lung cancer screening programmes, it is recommended that smoking cessation advice is delivered in conjunction (Oudkerk et al., 2017; U.S. Preventive Services Task Force, 2016). Therefore, most lung screening settings and trials include a smoking cessation component. To reflect the way that screening programmes are currently delivered in practice, studies conducted within lung screening studies were not excluded on the basis of the provision of brief smoking cessation advice given alongside the screening procedure. In general, screening was the main exposure for these studies, and studies explicitly assessing the efficacy of smoking cessation interventions alongside cancer screening were excluded.

3.2.2.4 Types of outcome measures

The primary outcomes of interest for this review are four cancer-related health behaviours: diet (limited to red and processed meat, fruit and vegetables, fibre and wholegrain, dairy, and the consumption of fish), physical activity, smoking, and alcohol consumption. Secondary outcomes include three indicators of health behaviour (weight, BMI, adiposity). To be included in the review, studies must have measured one of the primary or secondary outcomes before and after screening attendance.
3.2.2.5 Additional criteria

Eligible studies were limited to those published in the English language and published in peer-reviewed journals. No date limits were imposed.

3.2.3 Information sources

The following bibliographic databases were included in the literature search: MEDLINE (Ovid, 1946-2019), PsycINFO (Ovid, 1806-2019), EMBASE (Ovid, 1947-2019) and Web of Science (1945-2019). The electronic search was supplemented with hand searches of reference lists and forward citation searching of identified studies and existing reviews of the topic area. If conference abstracts or research protocols were identified, attempts were made to find the associated peer-reviewed research studies. Two searches were carried out. The first search was conducted on 9th May 2016. The first search was used to identify gaps in the literature, and informed the development of study 2 (Chapter 4). The second search was conducted on 26th February 2019, in order to ensure that the information presented in this systematic review was up to date prior to the submission of this thesis.

3.2.4 Search strategy

The search strategy was developed using title and keywords from known papers within the research field, alongside searches for relevant terminology within the Medical Subject Headings (MeSH) database. The search focused on groups of terms relating to cancer screening, health behaviour, and teachable moments. To be identified in the search, papers were required to contain a word in each of these categories within their title or abstract or keywords. Further details of the search strategy can be found in 3.

3.2.5 Study selection

After duplicate records were removed, one author (CS) screened titles. A second author reviewed 10% of titles (RB). Abstracts of 100% of the remaining records were screened for relevance by two authors (CS, RB). Two authors (CS, RB) screened the full texts. Disagreements in study selection were dealt with by discussion between the two authors. One author (CS) conducted hand searches of references and forward citation searches of the remaining records.
3.2.6 Data collection and process

Data were extracted by one author (CS), and 100% of the extraction sheets were checked by a second reviewer (CV). Discrepancies in data extraction between the two reviewers were resolved by discussion. The following data were extracted from each record: study authors, year of publication, title, reference, screening programme, exposure, country, whether data were collected as part of a screening trial or as part of an established screening programme, recruitment method, sample size, sample characteristics, study design (RCT or observational), study aim, follow-up period, outcomes and results. Change scores were calculated for each study to estimate change in outcomes over time (baseline values minus follow-up values; figures 3.2-3.6). Scores were calculated separately for each trial arm, where relevant. Where studies included more than one trial arm, a difference in change score was calculated to estimate change between groups over time (Change in screened group minus change in unscreened group). The data extraction sheet was piloted on one study of each research design, then refined.

3.2.7 Risk of bias of individual studies

Risk of bias was assessed separately for RCTs and observational studies. For RCTs, the Cochrane Collaboration’s tool for assessing risk of bias (v2; ROB-2) was used (Higgins et al., 2016). The ROB-2 is an updated version of the widely used, validated, Cochrane Collaboration’s tool for assessing risk of bias in randomised trials (Higgins et al., 2011). In lieu of a widely accepted tool for assessing observational studies, criteria from the ROBINS-I (Risk Of Bias In Non-randomised Studies of Interventions) tool were applied (Sterne et al., 2016). The ROBINS-I is a relatively new tool but is widely used, reflected by more than 1,000 citations since its publication in 2016. A summary of domains assessed by the ROB-2 and ROBINS-I are presented in Table 3.1. Using the ROB-2 RCTs were assigned a score of low, some concerns, or high risk of bias, or no information for each of the domains. Using the ROBINS-I, observational studies were assigned a score of low, moderate, serious, or critical risk of bias, or no information.
Table 3.1. Summary of domains assessed by the ROB-2 and ROBINS-I

<table>
<thead>
<tr>
<th>Domain</th>
<th>ROB-2a</th>
<th>ROBINS-Ib</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias due to confounding</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Bias in the selection of participants into the study</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Bias in the classification of interventions</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Bias arising from the randomisation process</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Bias due to deviations from the intended interventions</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bias due to missing outcome data</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bias in the measurement of the outcome</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bias in the selection of the reported result</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

a Risk of bias was rated as low, some concerns, high or no information
b Risk of bias was rated as low, moderate, serious, critical or no information

3.2.8 Data analysis and synthesis

If it had been possible data would have been meta-analysed (Higgins, Green, & Cochrane, 2008). However, there was a high degree of methodological heterogeneity in the identified studies (further details in section 3.3.8), therefore, a narrative review of studies was conducted.

3.3 Results

3.3.1 Study selection

Searches of the Medline, Embase, PsycINFO and Web of Knowledge databases generated 5,642 results (4,371 after deduplication). An additional eight records were identified following forward and backwards citation searches. At the title screening stage, 3,518 records were excluded. Of the 853 screened abstracts, 762 records were excluded. A total of 91 full-text records were assessed for eligibility, resulting in 29 meeting criteria for inclusion in the review. The most common reason for exclusion at the full-text stage (k=261) was that the record was not an empirical article published within a peer-reviewed journal; this included editorials, conference abstracts and theses. Twenty-one studies were excluded as they did not have a prospective

1 k= is used to denote the number of studies, n= is used to denote the number of participants within studies
design, 12 studies did not measure the outcomes of interest, and three studies were excluded as they reported the wrong population, intervention or setting. A PRISMA flow diagram of the study selection is presented in Figure 3.1.

Figure 3.1. PRISMA flow diagram of study selection
3.3.2 Study characteristics

Twenty-nine studies met the criteria for inclusion in the review. Sixteen studies were published since 2010, when the last review of health behaviour change in multiple screening contexts was conducted (van der Aalst, van Klaveren, et al., 2010).

Characteristics of the included studies are presented in Table 3.2. Twenty-one of the studies were conducted within the context of lung screening, and eight were conducted within the context of bowel screening. No studies exploring behaviour change following breast or cervical screening were identified. All but one of the studies included smoking as an outcome variable (Sriphanlop et al., 2018). Other outcomes included physical activity (k=7), diet (k=7), alcohol consumption (k=3), weight (k=3) and BMI (k=3). The majority of the identified studies used an observational research design (k=20), three of which included unscreened comparator groups. The remaining nine studies were RCTs. The follow-up periods ranged from two weeks (Brain et al., 2017) to 13 years (Hoff et al., 2001). More than half of the studies were conducted within the USA (k=16). Just three studies were conducted within the UK (Brain et al., 2017; Miles et al., 2003; Stevens, Smith, Vrinten, Waller, & Beeken, 2018).

Most of the included studies were set within trials of new screening programmes (k=24), with just five studies reporting data from existing or established screening programmes. Multiple studies reported data from the same trials and screening programmes. Accounting for multiple analyses of participants within the same trial or programme, data for 114,784 participants were included in this review. The sample sizes at baseline ranged from 55 (Schnoll et al., 2002) to 80,752 (Barry et al., 2012).
Table 3.2. Characteristics of included studies

<table>
<thead>
<tr>
<th>Author Details</th>
<th>Exposure</th>
<th>Study design</th>
<th>Baseline Sample Characteristics</th>
<th>Outcomes</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First author, year</strong></td>
<td><strong>Country</strong></td>
<td><strong>Programme, exposure</strong></td>
<td><strong>Study design</strong></td>
<td><strong>Sample size</strong></td>
<td><strong>Age in years, mean (SD/ range)</strong></td>
</tr>
<tr>
<td>Anderson, 2009</td>
<td>USA</td>
<td>Lung screening, annual CT</td>
<td>Observational</td>
<td>ELCAP</td>
<td>2,078</td>
</tr>
<tr>
<td>Ashraf, 2009</td>
<td>Denmark</td>
<td>Lung screening, annual LDCT</td>
<td>RCT</td>
<td>DLCST</td>
<td>4,104</td>
</tr>
<tr>
<td>Ashraf, 2014</td>
<td>Denmark</td>
<td>Lung screening, five annual LDCT screenings</td>
<td>RCT</td>
<td>DLCST</td>
<td>4,104</td>
</tr>
<tr>
<td>Barry, 2012</td>
<td>USA</td>
<td>Lung screening, up to four annual chest x-rays</td>
<td>RCT</td>
<td>PLCO</td>
<td>80,752</td>
</tr>
<tr>
<td>Berstad, 2015</td>
<td>Norway</td>
<td>Bowel screening, single FS</td>
<td>RCT</td>
<td>NORCCAP</td>
<td>8,484</td>
</tr>
<tr>
<td>Borondy Kitts, 2016</td>
<td>USA</td>
<td>Lung screening, LDCT</td>
<td>Observational</td>
<td>1,483</td>
<td>62.5 (6.0)</td>
</tr>
<tr>
<td>Brain, 2017</td>
<td>UK</td>
<td>Lung screening, single LDCT</td>
<td>RCT</td>
<td>UKLS</td>
<td>1,546</td>
</tr>
<tr>
<td>Clark, 2016</td>
<td>USA</td>
<td>Lung screening, 3 annual screenings (participants)</td>
<td>Observational</td>
<td>NLST; ACRIN arm</td>
<td>18,840</td>
</tr>
</tbody>
</table>

1 ELCAP = Early Lung Cancer Action Project, DLCST = Danish Lung Cancer Screening Trial, PLCO = Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial, NORCCAP = Norwegian Colorectal Cancer Prevention trial, UKLS = UK Lung Screening Trial, NLST = National Lung Screening Trial (American College of Radiology Imaging Network / Lung Screening Study cohorts), TPS-I = Telemark Polyp Study, PALCAD = ProActive Lung Cancer Detection study, MLP = Mayo Lung Project, PLUSS = Pittsburgh Lung Screening Study.
<table>
<thead>
<tr>
<th>Author Details</th>
<th>Exposure</th>
<th>Study design</th>
<th>Baseline Sample Characteristics</th>
<th>Outcomes</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cox, 2003</strong> USA</td>
<td>Lung screening, single spiral LDCT</td>
<td>Observational</td>
<td>Mayo clinic 1,475 59.0 (6.5; current smokers); 60.7 (6.8; former smokers) 49.7%; 54.5%</td>
<td>Smoking</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>Helander, 2017</strong> Finland</td>
<td>Bowel screening, single FOBT</td>
<td>RCT</td>
<td>4,535 All participants age 60 at time of screening 44.4%</td>
<td>Smoking Physical activity Diet BMI</td>
<td>2 years</td>
</tr>
<tr>
<td><strong>Hoff, 2001</strong> Norway</td>
<td>Bowel screening, single FS</td>
<td>Observational (with matched control group)</td>
<td>TPS-I 799 Participants aged 50-59 at baseline. Not reported.</td>
<td>Smoking BMI</td>
<td>13 years</td>
</tr>
<tr>
<td><strong>Kaufman, 2018</strong> USA</td>
<td>Lung screening, 3 annual screenings (randomised to LDCT or chest x-ray)</td>
<td>Observational</td>
<td>NLST; ACRIN arm 2,738 60.8 (4.8) 55.7%</td>
<td>Smoking</td>
<td>6.1 years</td>
</tr>
<tr>
<td><strong>Knudsen, 2018</strong> Norway</td>
<td>Bowel screening, participants randomised to five biennial FIT or single FS</td>
<td>Observational (with matched control group)</td>
<td>Bowel cancer screening in Norway study 21,832 61.7 (6.8; FIT) 62.1 (7.1; FS) 62.8 (6.5; control) 48.3% (FIT) 48.4% (FS) 50.5% (control)</td>
<td>Smoking Physical activity Alcohol Diet Weight</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>Kumar, 2016</strong> USA</td>
<td>Lung screening, randomised to single LDCT or x-ray</td>
<td>Observational</td>
<td>NLST; ACRIN arm 6,813 Median age 60 (range 50-74) 54.69%</td>
<td>Smoking</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>Larsen, 2007</strong> Norway</td>
<td>Bowel screening, single FS</td>
<td>RCT</td>
<td>NORCCAP 8,198 Not reported.</td>
<td>Not reported.</td>
<td>3 years</td>
</tr>
<tr>
<td><strong>MacRedmond, 2006</strong> Ireland</td>
<td>Lung screening, single LDCT</td>
<td>Observational</td>
<td>PALCAD 449 56.4 years (50–74) Not reported.</td>
<td>Smoking</td>
<td>2 years</td>
</tr>
</tbody>
</table>

2 Sample limited to Black and White participants.
<table>
<thead>
<tr>
<th>Author Details</th>
<th>Exposure</th>
<th>Study design</th>
<th>Baseline Sample Characteristics</th>
<th>Outcomes</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First author, year, Country</strong></td>
<td><strong>Programme, exposure</strong></td>
<td><strong>Study design</strong></td>
<td><strong>Sample size</strong></td>
<td><strong>Age in years, mean (SD/ range)</strong></td>
<td><strong>Male, %</strong></td>
</tr>
<tr>
<td>Miles, 2003, UK</td>
<td>Bowel screening, single FS screening</td>
<td>Observational</td>
<td>UKFS</td>
<td>3,789</td>
<td>60.7 (2.9)&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ostroff, 2001, USA</td>
<td>Lung screening, annual LDCT</td>
<td>Observational</td>
<td>ELCAP</td>
<td>134</td>
<td>67 (8.6)</td>
</tr>
<tr>
<td>Park, 2013, USA</td>
<td>Lung screening, 3 annual screenings (randomised to LDCT or chest x-ray)</td>
<td>Observational</td>
<td>NLST; ACRIN arm</td>
<td>430</td>
<td>60.1 (not reported)</td>
</tr>
<tr>
<td>Schnoll, 2002, USA</td>
<td>Lung screening, Single sputum cytology, chest X-ray, spiral CT and light-induced fluorescence endoscopy</td>
<td>Observational</td>
<td></td>
<td>55</td>
<td>51.1 (11.4)</td>
</tr>
<tr>
<td>Shi, 2011, USA</td>
<td>Lung screening, chest x-ray every 3-4 months with sputum cytology</td>
<td>RCT</td>
<td>MLP</td>
<td>9,211</td>
<td>Not reported</td>
</tr>
<tr>
<td>Sriphanlop, 2018, USA</td>
<td>Bowel screening, single colonoscopy</td>
<td>Observational</td>
<td></td>
<td>565</td>
<td>59.0 (7.3)</td>
</tr>
<tr>
<td>Stevens, 2018, England</td>
<td>Bowel screening, single FOBT</td>
<td>Observational (unscreened comparator group)</td>
<td></td>
<td>774</td>
<td>60-61</td>
</tr>
<tr>
<td>Styn, 2009, USA</td>
<td>Lung screening, single LDCT and pulmonary function test</td>
<td>Observational</td>
<td>PLuSS</td>
<td>2,142</td>
<td>Median 57 (IQR 53-63 years)</td>
</tr>
<tr>
<td>Tammemägi, 2014, USA</td>
<td>Lung screening, 3 annual screenings (randomised to LDCT or chest x-ray)</td>
<td>Observational</td>
<td>NLST; LSS arm</td>
<td>15,489</td>
<td>60.6 years (4.7)</td>
</tr>
</tbody>
</table>

<sup>3</sup> Data taken from original dataset (not reported in paper).
<table>
<thead>
<tr>
<th>First author, year</th>
<th>Country</th>
<th>Programme, exposure</th>
<th>Study design</th>
<th>Sample size</th>
<th>Age in years, mean (SD/ range)</th>
<th>Male, %</th>
<th>Outcomes</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taylor, 2007</td>
<td>USA</td>
<td>Lung screening, 3 annual screenings (randomised to LDCT or chest x-ray)</td>
<td>Observational</td>
<td>NLST; LSS and ACRIN arms</td>
<td>313</td>
<td>64.8 (SD 5.6; LSS) 65.2 (4.9; LSS) 60.9 (SD 4.7; ACRIN) 62.5 (SD=4.8; ACRIN)</td>
<td>51.8% (LSS) 59% (LSS) 57% (ACRIN) 48.9% (ACRIN)</td>
<td>Smoking</td>
</tr>
<tr>
<td>Townsend, 2005</td>
<td>USA</td>
<td>Lung screening, 3 annual LDCT screenings</td>
<td>Observational</td>
<td>Mayo clinic</td>
<td>1,520</td>
<td>59.1 (6.5; baseline smokers); 60.7 (6.7; recent quitters); 60.7 (7.1; long-term quitters)</td>
<td>50%; 54%; 57%</td>
<td>Smoking</td>
</tr>
<tr>
<td>van der Aalst, 2010</td>
<td>Netherlands / Belgium</td>
<td>Lung screening, LDCT at years 1, 2, and 4</td>
<td>RCT</td>
<td>NELSON</td>
<td>1,284</td>
<td>Median 58 (IQR 7)</td>
<td>100%</td>
<td>Smoking</td>
</tr>
<tr>
<td>van der Aalst, 2011</td>
<td>Netherlands / Belgium</td>
<td>Lung screening, LDCT at years 1, 2, and 4</td>
<td>Observational</td>
<td>NELSON</td>
<td>1,284</td>
<td>58.0 (5.0)</td>
<td>100%</td>
<td>Smoking</td>
</tr>
</tbody>
</table>
Chapter 3. Spontaneous behaviour change following cancer screening: systematic review

3.3.3 Smoking
All but one study included in this review measured smoking before and after participation in cancer screening. Twenty-one were conducted within the context of lung screening, and a further seven within the context of bowel screening. All studies observed reductions in rates of smoking over time. However, evidence from RCTs suggests that reductions in rates of smoking are not related to screening participation, due to broadly similar rates of smoking in screened and control groups. The following sections will summarise the results from lung and bowel screening settings in turn. Within each screening programme, results are separated by study design (RCT vs observational).

3.3.3.1 Results of studies conducted within lung screening settings

3.3.3.1.1 Randomised controlled trials
Six studies reported smoking cessation within RCTs of lung screening programmes (Ashraf et al., 2014; Ashraf et al., 2009; Barry et al., 2012; Brain et al., 2017; Shi & Iguchi, 2011; van der Aalst, van den Bergh, et al., 2010). All studies reported a reduction in smoking rates over time, most studies did not find differences in rates of smoking cessation between participants in the screened and control groups, including the largest study and only RCT to be rated as low risk of bias (Ashraf et al., 2014).

Characteristics of the studies are presented in Table 3.2, and a summary of results can be found in Figure 3.2. Four studies from three separate trials reported on LDCT screening (Ashraf et al., 2014; Ashraf et al., 2009; Brain et al., 2017; van der Aalst, van den Bergh, et al., 2010) and two on screening by chest x-ray (Barry et al., 2012; Shi & Iguchi, 2011). Four studies were conducted in the USA (Ashraf et al., 2014; Ashraf et al., 2009; Barry et al., 2012; Shi & Iguchi, 2011), one in the UK (Brain et al., 2017) and one in the Netherlands and Belgium (van der Aalst, van den Bergh, et al., 2010). Three studies included baseline smokers only (Brain et al., 2017; Shi & Iguchi, 2011; van der Aalst, van den Bergh, et al., 2010), and three included both smokers and former smokers (Ashraf et al., 2014; Ashraf et al., 2009; Barry et al., 2012). Follow-up ranged from two weeks (Brain et al., 2017) to eight and a half years (Barry et al., 2012). Participant retention varied from 46.8% (Barry et al., 2012) to 90.6% (van der Aalst, van den Bergh, et al., 2010). A range of outcome measures were used, including point prevalent abstinence (Brain et al., 2017; van der Aalst, van den Bergh, et al., 2010), four week prevalent abstinence (Ashraf et al., 2014;
Ashraf et al., 2009), 30 day point prevalent abstinence (Barry et al., 2012) and whether participants had smoked one cigarette per day over the past year (Shi & Iguchi, 2011).

Data from three trials of LDCT lung screening provide conflicting accounts of the impact of lung screening on smoking cessation. Two trials (Ashraf et al., 2014; Ashraf et al., 2009; van der Aalst, van den Bergh, et al., 2010) report higher reductions in smoking rates in the control group (20.1%\(^5\) and 19.8%) versus the screened group (18.7% and 15.1%) at five and two-year follow-up respectively\(^6\). However, this difference was only reported as statistically significant in the study by van der Aalst and colleagues (2010), and only in complete case analyses not intention to treat (ITT) analyses. The trial reported by Ashraf et al. (2014) was the only RCT to use biochemical verification of smoking status, a contributing factor to this study receiving a low risk of bias rating. The third trial (Brain et al., 2017) reports higher rates of smoking cessation in the screened (23.6%) versus the control group (21.0%) at two-year follow-up\(^7\), although this study had much lower levels of participant retention (see Figure 3.2). In this trial, differences in rates of cessation were significant in ITT analyses but not complete case analyses.

Neither trial assessing smoking cessation following chest x-ray lung screening found a difference in rates of cessation between control and screened groups (Barry et al., 2012; Shi & Iguchi, 2011). One study reported a reduction in smoking rates of 15.9% in the control group and 14.9% in the screened group (Shi & Iguchi, 2011). The other study reported much lower rates of cessation across control (3.6%) and screened groups (3.4%) at eight and a half year follow-up (Barry et al., 2012). However, this study had a much lower baseline rate of smoking (~18%), suggesting that the sample may not be comparable to other lung screening trials.

\(^5\) Percentage reductions are presented in absolute terms.
\(^6\) Additional follow-up time-points reported by Ashraf et al., 2009 and Ashraf et al., 2014 for the DLCST are all in the same direction at 1, 2, 3, and 4 years follow-up.
\(^7\) Two-week follow-up data reported by Brain et al., 2017 reports greater reductions in smoking in screened group compared to control group in complete case and ITT analyses.
3.3.3.1.2 Observational studies

The remaining 15 studies conducted within lung screening settings used pre-post observational designs (Anderson et al., 2009; Borondy Kitts et al., 2016; Clark et al., 2016; Cox et al., 2003; Kaufman, Dwyer, Land, Klein, & Park, 2018; Kumar et al., 2016; MacRedmond et al., 2006; Ostroff et al., 2001; Park et al., 2013; Schnoll et al., 2002; Styn et al., 2009; Tammemägi, Berg, Riley, Cunningham, & Taylor, 2014; Taylor et al., 2007; Townsend et al., 2005; van der Aalst, van Klaveren, van den Bergh, Willemsen, & de Koning, 2011). Similarly to the RCTs, observational studies appear to show a positive effect of lung screening on smoking cessation. However, there are large differences in reductions in smoking rates dependent on whether the samples included former smokers in their baseline samples. All of the studies were single-arm. Therefore, it is not possible to determine whether rates of cessation were greater than would be observed in unscreened populations. A summary of the results of observational studies is presented in Figure 3.2.

Characteristics of the studies are presented in Table 3.2. In eight studies participants received LDCT screening (Anderson et al., 2009; Borondy Kitts et al., 2016; Cox et al., 2003; MacRedmond et al., 2006; Ostroff et al., 2001; Styn et al., 2009; Townsend et al., 2005; van der Aalst et al., 2011). In six studies participants were randomised to receive either LDCT or chest x-ray (Clark et al., 2016; Kaufman et al., 2018; Kumar et al., 2016; Park et al., 2013; Taylor et al., 2007; Townsend et al., 2005). In one study, the screening consisted of multiple modalities (Schnoll et al., 2002). All studies were conducted in the USA, except one which was conducted in Ireland (MacRedmond et al., 2006) and another in the Netherlands (van der Aalst et al., 2011). Follow-up ranged from one month (Schnoll et al., 2002) to seven years (Tammemägi et al., 2014). Participant retention ranged from 70.9% (Schnoll et al., 2002) to 98.5% (Borondy Kitts et al., 2016). Two-thirds of studies included only baseline smokers in their samples, while five studies included both baseline smokers and former smokers (Anderson et al., 2009; Borondy Kitts et al., 2016; MacRedmond et al., 2006; Park et al., 2013; Taylor et al., 2007). Most studies used point prevalent abstinence, however, three studies used seven day point prevalent abstinence as the outcome measure (Schnoll et al., 2002; Tammemägi et al., 2014; van der Aalst et al., 2011), one study used 30 day point prevalent abstinence (Anderson et al., 2009), one study used 6 month
continuous abstinence (Kumar et al., 2016) and one study did not report how they categorised smokers (MacRedmond et al., 2006).

Most studies were set within the context of LDCT lung screening, of which three included current smokers and former smokers in their samples (Anderson et al., 2009; Borondy Kitts et al., 2016; MacRedmond et al., 2006). Rates of smoking decreased by 4.7%, 4.6% and 7.1% respectively. The study by MacRedmond and colleagues (2005) had the highest number of smokers in their sample at baseline (68.4%), and also reported the greatest reduction in the proportion of smokers between baseline and follow-up. There did not appear to be a clear pattern between length of follow-up and reductions in smoking, with the study with the longest follow-up (Anderson et al., 2009; up to 6 years) reporting similar rates of smoking cessation to the study with the shortest follow-up (Borondy Kitts et al., 2016; 1.5 years). It is important to note the study by Borondy Kitts and colleagues (2016) sought to investigate rates of smoking cessation and relapse among individuals undergoing follow-up LDCT scans. The findings of this study must be interpreted with caution as no distinction is made between people whose follow-up scan was part of the usual screening interval, or as part of an investigation following an initial positive LDCT screen.

A further five studies exploring changes in smoking rates following LDCT included only baseline smokers in their sample (Cox et al., 2003; Ostroff et al., 2001; Styn et al., 2009; Townsend et al., 2005; van der Aalst et al., 2011). Data from the PLuSS trial reports a reduction in smoking of 15.5% one year after LDCT screening. The interpretation of the other four studies is complicated by the fact that multiple papers have been published from the same trials, using overlapping samples or different follow-up periods. Two studies reported data from the Mayo Lung Clinic one (Cox et al., 2003), two and three years after a single LDCT screen (Townsend et al., 2005). A reduction in smoking rates of 14.3% was observed at one-year follow-up, followed by 22.4% at two-year follow-up and 24.2% at three-year follow-up. Similarly high rates of smoking cessation were reported by Ostroff et al., (2001; 23.1%). However, the sample size of this study was small, and overlapped with other data from the ELCAP trial reported by Anderson et al., (2009). Data

---

8 Correspondence with the lead author of this study did not clarify the sample and screening exposure.
from the screened arm of the NELSON trial (van der Aalst et al., 2011) overlaps with RCT data from both arms of the trial (van der Aalst, van den Bergh, et al., 2010). The study drew a random sample of smokers from the trial who received normal and indeterminate screening results, and compared rates of smoking cessation (van der Aalst et al., 2011). Across the two groups, smoking fell by 11.2% at two-year follow-up.

Six studies were nested within the NLST, where participants were randomised to receive LDCT or chest x-ray lung screening (Clark et al., 2016; Kaufman et al., 2018; Kumar et al., 2016; Park et al., 2013; Tammemägi, Berg, Riley, Cunningham, & Taylor, 2014; Taylor et al., 2007). The trial was conducted by two groups working in collaboration; the American College of Radiology Imaging Network (ACRIN) and the Lung Screening Study (LSS). Clark et al. (2016) reported results for smoking cessation outcomes for the full NLST ACRIN sample, including baseline smokers and former smokers (n=18,840). At one year follow-up, a modest 1.5% reduction in smoking rates was reported (baseline smoking rates of 49.3%). At five year follow-up, there had been a reduction in rates of smoking of 4.8%. Data from the NLST LSS sample was reported using baseline smokers only (n=34,612; Tammemägi et al., 2014). Rates of smoking had fallen by 14.2% at one-year follow-up, increasing to 39.3% by the seven-year follow-up. These two studies clearly show how including only smokers versus smokers and former smokers at baseline provide different pictures of the impact of lung screening on smoking rates.

A number of sub-studies were conducted with NLST ACRIN and LSS samples. One study explored differences in smoking cessation between Black and White NLST ACRIN baseline smokers (Kumar et al., 2016). Similar rates of smoking cessation (six-month continuous abstinence) were observed between Black (5.6%) and White (7.2%) participants one year after screening participation. One study used a subsample of 2,738 baseline smokers to determine how smoking-related health beliefs relate to smoking cessation (Kaufman et al., 2018). At follow-up (mean 6.1 years), 37.5% of the baseline smokers were reported to be former smokers. A subsample of 430 participants from eight NLST ACRIN sites (recruited December 2003 – March 2004) was used to determine changes in risk perceptions one-year after screening participation (Park et al., 2013). Smoking rates had fallen by 1.7% at one-year follow-up. Taylor et al., (2007)
drew subsamples of participants from both the NLST ACRIN (n=169) and LSS (n=144) sites and included baseline smokers and former smokers. At one month follow-up, there was a reduction in smoking rates of 1.1% across the two sites.

A final study used a combination of screening techniques including sputum cytology, chest X-ray, spiral CT and light-induced fluorescence endoscopy (Schnoll et al., 2002). The study included 39 baseline smokers and reported a reduction in rates of smoking of 23.1% at one-month follow-up.
### Figure 3.2: Summary of studies assessing changes in rates of smoking following participation in lung and bowel cancer screening

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Design</th>
<th>Baseline participant characteristics</th>
<th>Study quality</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kestel, 2014</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-18.7%</td>
</tr>
<tr>
<td>Sim, 2017</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-20.1%</td>
</tr>
<tr>
<td>van der Aalst, 2017</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-23.6%</td>
</tr>
<tr>
<td>Barry, 2012</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-21.0%</td>
</tr>
<tr>
<td>Thi, 2011</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-15.1%</td>
</tr>
<tr>
<td>Alvanon, 2009</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-19.8%</td>
</tr>
<tr>
<td>Gondrow/Kit, 2016</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-3.4%</td>
</tr>
<tr>
<td>Maloufaderd, 2006</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-3.6%</td>
</tr>
<tr>
<td>Syn, 2009</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-14.9%</td>
</tr>
<tr>
<td>Townsend, 2009</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-15.9%</td>
</tr>
<tr>
<td>Cork, 2016</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-4.7%</td>
</tr>
<tr>
<td>TiemlerM, 2016</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-4.8%</td>
</tr>
<tr>
<td>Rotter, 2002</td>
<td>RCT</td>
<td>Low admission</td>
<td>LOW</td>
<td>-23.1%</td>
</tr>
</tbody>
</table>
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3.3.3.2 Results of studies conducted within bowel screening settings

Seven studies assessed the impact of bowel screening on smoking. All studies exploring smoking cessation following bowel screening participation reported reductions in rates of smoking over time. However, evidence from RCTs suggests reductions in rates of smoking are similar across screened and control groups (Berstad et al., 2015; Helander, Heinavaara, Sarkeala, & Malila, 2017; Larsen et al., 2007). Four further observational studies, three with unscreened comparator groups, did not provide convincing support for bowel screening as a teachable moment for smoking cessation (Hoff et al., 2001; Knudsen et al., 2018; Miles et al., 2003; Stevens et al., 2018).

3.3.3.2.1 Randomised controlled trials

Three RCTs exploring smoking cessation within the context of bowel screening were identified (Berstad et al., 2015; Helander et al., 2017; Larsen et al., 2007). Two studies reported no difference in reductions in smoking between groups (Berstad et al., 2015; Helander et al., 2017). One study found a negative impact of FS participation on rates of smoking cessation at three years (Larsen et al., 2007), however long-term follow-up within the same sample suggests this negative effect may only exist in the short term (Berstad et al., 2015).

Characteristics of the studies are presented in Table 3.2 and a summary of results in Figure 3.2. Two studies reported on data from the same trial conducted in Norway (Berstad et al., 2015; Larsen et al., 2007), and the third study reported data from the Finnish national screening programme (Helander et al., 2017). Two studies used a sample undergoing FS screening (Berstad et al., 2015; Larsen et al., 2007) and one used a sample of FOBT participants (Helander et al., 2017). Follow-up periods ranged from two (Helander et al., 2017) to eleven years (Berstad et al., 2015).

Rates of smoking fell equally across both the screened and control groups in most studies. At two-year follow-up, rates of smoking had fallen by 1.0% among FOBT participants, and 1.3% in the control group (Helander et al., 2017). However, in the RCT of FS screening, rates fell more steeply in the control group (5.9%) compared with the screened group (1.9%) at three year-follow-up (Larsen et al., 2007). By eleven-year follow-up, there was no difference in reductions in
smoking between control and screened groups (13.5% and 15.2% respectively; Berstad et al., 2015). Rates of change in the proportion of smokers were similar in the screened groups in the studies by Larsen et al. (2007) and Helander et al., (2017), despite different rates of smoking at baseline (17.9% versus 37.1% respectively) and different screening modalities (FOBT versus FS).

3.3.3.2 Observational studies

Four observational studies have also attempted to understand whether bowel screening prompts changes to smoking behaviour (Hoff et al., 2001; Knudsen et al., 2018; Miles et al., 2003; Stevens et al., 2018). Reductions in rates of smoking were observed in all studies but were generally low. A summary of results is presented in Figure 3.2.

Characteristics of the studies are presented in Table 3.2. One study used a single-arm observational design (Miles et al., 2003), two studies used two-arm designs (Stevens et al., 2018; Hoff et al., 2001), and one study used a three-arm design (Knudsen et al., 2018). Two studies were conducted within the UK (Miles et al., 2003; Stevens et al., 2018) and two studies were conducted in Norway (Hoff et al., 2001; Knudsen et al., 2018). Two studies reported on samples undergoing FS screening (Hoff et al., 2001; Miles et al., 2003), one study compared participants undergoing FS screening, FIT screening and an unscreened comparator group (Knudsen et al., 2018), and one study compared participants undergoing FOBT screening with an unscreened comparator group (Stevens et al., 2018). The follow-up periods ranged from three months (Miles et al., 2003) to two years (Stevens et al., 2018).

Knudsen and colleagues (2018) reported that rates of smoking reduced to the same extent among FS participants (0.6%), FIT participants (1.0%) and the matched comparator group (0.6%), at one-year follow-up. Stevens et al. (2018) reported a 1.0% reduction in rates of smoking among FOBT participants, compared with a 4.8% reduction (non-significant) in FOBT non-participants. The sample selection for this study was different from others, as prospective data from the English Longitudinal Study of Aging were used. Unlike other studies, there were large differences in

9 This study is presented in Chapter 4.
baseline smoking between the comparator group and screened group (21.7% versus 11.1%). One study reported half (52%) of patients with screen-detected colorectal polyps “improved their smoking category”, which was not defined in the paper, compared with 44% of people without polyps (Hoff et al., 2001). In addition, 1.4% of patients with polyps worsened their smoking category, compared with 6% of patients without colorectal polyps. Finally, the only study which did not include an unscreened comparator group found a 1.5% reduction in the proportion of smokers three months after FS participation.

3.3.4 Physical activity

Seven of the identified studies explored changes in physical activity following participation in bowel screening. No studies exploring changes in physical activity following lung screening were identified. Studies spanned a range of screening modalities, including FS (Berstad et al., 2015; Knudsen et al., 2018; Larsen et al., 2007; Miles et al., 2003), FIT (Knudsen et al., 2018), FOBT (Helander et al., 2017; Stevens et al., 2018) and colonoscopy (Sriphanlop et al., 2018).

None of the three RCTs reported positive changes to physical activity following bowel screening participation (Berstad et al., 2015; Helander et al., 2017; Larsen et al., 2007). Most observational studies reported positive changes to physical activity following bowel screening, but just one study found increased physical activity among screened participants compared with an unscreened comparator group.

3.3.4.1 Randomised controlled trials

Three studies used a randomised controlled design to explore changes in PA following bowel screening (Berstad et al., 2015; Helander et al., 2017; Larsen et al., 2007). Changes in physical activity were minimal in both the screened and control groups in all three studies. A small negative impact, or health certificate effect, of FS screening on changes to physical activity was reported in one trial at three-year follow-up (Larsen et al., 2007). However, the 11-year follow-up from the same trial did suggest this effect is not maintained in the long term.

The lead author of the paper was contacted but the data needed to assess the impact of FS on smoking behaviour were unavailable.
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Characteristics of the studies are presented in Table 3.2 and a summary of results in Figure 3.3. Two studies reported on data from the NORCCAP trial conducted in Norway, three and eleven years after screening participation (Berstad et al., 2015; Larsen et al., 2007), and the third study reported data from the Finnish national screening programme two years after participation (Helander et al., 2017). Two studies used a sample undergoing FS screening (Berstad et al., 2015; Larsen et al., 2007) and one used a sample of FOBT participants (Helander et al., 2017). Each RCT used a different method to assess levels of physical activity. One study assessed changes to the number of exercise sessions of at least 20 minutes (Berstad et al., 2015; Larsen et al., 2007). Another study scored participants (scores between 2-12) based on the frequency of exercises that did and did not result in sweating (Larsen et al., 2007). Helander et al. (2017) assessed changes in the proportion of participants engaging in 4 or more hours a week of light or moderate physical activity or 30 or minutes of vigorous physical activity per day.

The three studies provide differing accounts of bowel screening as a prompt for changes to physical activity. Larsen et al. (2007) reported a small but statistically significant increase in exercise score from baseline to follow-up in the control group (+0.2), but no difference in exercise score in the screened group. Berstad et al. (2015) found a 0.1 increase in the number of 20-minute exercise sessions per day across both the screened and control groups. While the measures used by Larsen et al. (2007) and Berstad et al. (2015) are not comparable, it is encouraging that changes in PA were in a similar direction in both studies. Finally, Helander et al. (2018) found a 0.8% reduction in their physical activity measure in the screened group, compared with a 0.7% reduction in the unscreened group.
**Figure 3.3 Summary of studies assessing changes in physical activity following participation in bowel cancer screening**

<table>
<thead>
<tr>
<th>Study Year</th>
<th>Study Design</th>
<th>Setting</th>
<th>Baseline participant characteristics</th>
<th>Follow-up (in years)</th>
<th>Study Population</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>RCT</td>
<td>Norway</td>
<td>Male: 50%, Female: 50%</td>
<td>4</td>
<td>21,822</td>
<td>Increase in physical activity by 30%</td>
</tr>
<tr>
<td>2011</td>
<td>RCT</td>
<td>Denmark</td>
<td>Male: 60%, Female: 40%</td>
<td>4</td>
<td>3,500</td>
<td>Increase in physical activity by 35%</td>
</tr>
<tr>
<td>2012</td>
<td>RCT</td>
<td>Sweden</td>
<td>Male: 55%, Female: 45%</td>
<td>5</td>
<td>7,800</td>
<td>Increase in physical activity by 25%</td>
</tr>
<tr>
<td>2013</td>
<td>RCT</td>
<td>Norway</td>
<td>Male: 52%, Female: 48%</td>
<td>5</td>
<td>5,400</td>
<td>Increase in physical activity by 30%</td>
</tr>
<tr>
<td>2014</td>
<td>RCT</td>
<td>Sweden</td>
<td>Male: 58%, Female: 42%</td>
<td>6</td>
<td>9,200</td>
<td>Increase in physical activity by 20%</td>
</tr>
</tbody>
</table>

**Notes:**
- Multiple studies report data from the same trial. When multiple publications are available, the study with the most comprehensive or most data was selected. Data in the following table is included from the summary of results. To aid interpretation, model: Larson et al., 2007.
3.3.4.2 Observational studies

Changes in PA were explored using a pre-post observational design in four studies (Knudsen et al., 2018; Miles et al., 2003; Sriphanlop et al., 2018; Stevens et al., 2018). Just one study found a greater increase in the proportion of FOBT participants taking part in vigorous physical activity, compared with screening non-participants (Stevens et al., 2018). However, none of the other studies supported the hypothesis of cancer screening as a teachable moment for physical activity. A summary of results is presented in Figure 3.3.

Characteristics of the studies are presented in Table 3.2. Two studies used single-arm observational designs (Miles et al., 2003; Sriphanlop et al., 2018), one study used a two-arm design (Stevens et al., 2018), and one study used a three-arm design (Knudsen et al., 2018). Two studies were conducted within the UK (Miles et al., 2003; Stevens et al., 2018), one in Norway (Knudsen et al., 2018), and one in the USA (Sriphanlop et al., 2018). One study reported on samples undergoing FS screening (Miles et al., 2003), one study compared participants undergoing FS screening or FIT screening with an unscreened comparator group (Knudsen et al., 2018), one study compared participants undergoing FOBT screening with an unscreened comparator group, and one included participants who had undergone colonoscopy (Sriphanlop et al., 2018). Follow-up period ranged from one month (Sriphanlop et al., 2018) to two years (Stevens et al., 2018). All studies used different measures of physical activity, including the number of 30-minute sessions of physical activity per week (Knudsen et al., 2018), proportion of participants taking part in moderate and vigorous physical activity per week (Stevens et al., 2018), taking ‘regular exercise’ each week (Miles et al., 2003), and days per week engaging in at least 30 minutes moderate or strenuous exercise (Sriphanlop et al., 2018).

Of the studies that included unscreened comparator groups, one study which used only a male sample found a positive effect of screening participation on physical activity (Stevens et al., 2018). The number of men participating in vigorous physical activity once or more per week increased by 4.5% in screening attendees and decreased by 4.1% in men who did not participate following their first invitation to FOBT. This result was interpreted as an indication that bowel cancer screening may provide a teachable moment for physical activity. However, the same study found
that the proportion of men participating in moderate physical activity once or more per week 
decreased in both the screened (-3.0%) and unscreened group (-3.4%). In a comparison of FS, 
FIT and a comparator group, the mean number of 30-minute sessions of physical activity per 
week increased by the same amount (0.2) across all three groups (Knudsen et al., 2018).

Two single-arm studies with short follow-ups reported increases in physical activity following FS 
and colonoscopy (Miles et al., 2003; Sriphanlop et al., 2018). Three months after FS screening, 
the proportion of participants taking part in ‘regular exercise’ each week increased by 6.1%. 
However, the term ‘regular exercise’ was not clearly defined (Miles et al., 2003). One month after 
colonoscopy, the mean number of days participants engaged in 30 minutes of moderate or 
strenuous exercised increased by a modest 0.1 (Sriphanlop et al., 2018).

3.3.5 Diet

Changes in diet following participation in bowel screening were reported in seven of the 29 studies 
included in this review (Figure 3.4). Three studies used a randomised controlled design to explore 
changes in diet following bowel screening (Berstad et al., 2015; Helander et al., 2017; Larsen et 
al., 2007). A further four studies assessed changes in diet using a pre-post observational design 
(Miles et al., 2003; Sriphanlop et al., 2018; Stevens et al., 2018; Knudsen et al., 2018). There was 
a great deal of variation in the dietary outcomes assessed. Evidence will be presented separately 
for the consumption of fruits and vegetables (k=6), red and processed meat (k=3), and the 
consumption of fish (k=3) and for one study which calculated an index of diet quality. 
Characteristics of the studies are presented in Table 3.2.

Four studies reported increases in fruit and vegetable consumption following bowel screening. 
However, these changes were modest and were similar in control and comparator groups. 
Similarly, studies exploring changes in red and processed meat consumption and fatty fish 
consumption do not support cancer screening as a teachable moment for dietary change.
### Figure 3.4: Summary of studies assessing changes in diet following participation in bowel cancer screening

<table>
<thead>
<tr>
<th>Design</th>
<th>Baseline participant characteristics</th>
<th>Study quality</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Participant retention %</td>
<td>Outcome measure</td>
<td>Baseline</td>
</tr>
<tr>
<td></td>
<td>Sort</td>
<td>Age</td>
<td>Sex</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Author, year</strong></th>
<th><strong>Study design</strong></th>
<th><strong>Screening modality</strong></th>
<th><strong>Participants</strong></th>
<th><strong>Follow-up (years)</strong></th>
<th><strong>Setting</strong></th>
<th><strong>Baseline</strong></th>
<th><strong>Outcome measure</strong></th>
<th><strong>Change in outcome measure from baseline</strong></th>
<th><strong>Screened group vs control group +/-</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentat, 2018</td>
<td>RCT</td>
<td>Unscreened control</td>
<td>6,494</td>
<td>4.274</td>
<td>NORDCAP trial</td>
<td>52.7</td>
<td>49%</td>
<td>91%</td>
<td>71.2</td>
</tr>
<tr>
<td>Khudair, 2018</td>
<td>Crossover (three arms)</td>
<td>Unscreened control</td>
<td>21,632</td>
<td>7,873</td>
<td>Bowel cancer screening in Healthy study</td>
<td>61.7</td>
<td>40%</td>
<td>61%</td>
<td>12%</td>
</tr>
<tr>
<td>Stevens, 2018</td>
<td>Observational (two arms)</td>
<td>Unscreened comparator</td>
<td>524</td>
<td>347</td>
<td>Population representative survey</td>
<td>60-61</td>
<td>100%</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>Miles, 2003</td>
<td>Observational (single arm)</td>
<td>Unscreened comparator</td>
<td>3,789</td>
<td>177</td>
<td>UKF trial</td>
<td>60.7</td>
<td>46%</td>
<td>46%</td>
<td>47%</td>
</tr>
<tr>
<td>Miles, 2003</td>
<td>Observational (single arm)</td>
<td>Unscreened comparator</td>
<td>3,789</td>
<td>177</td>
<td>UKF trial</td>
<td>60.7</td>
<td>49%</td>
<td>49%</td>
<td>48%</td>
</tr>
<tr>
<td>Stempczynska, 2018</td>
<td>Observational (single arm)</td>
<td>Colonoscopy</td>
<td>986</td>
<td>596</td>
<td>Opportunistic screening programme</td>
<td>59.0</td>
<td>38%</td>
<td>62%</td>
<td>55%</td>
</tr>
<tr>
<td>Bentat, 2015</td>
<td>RCT</td>
<td>Unscreened control</td>
<td>8,404</td>
<td>4,210</td>
<td>NORDCAP trial</td>
<td>52.7</td>
<td>49%</td>
<td>81%</td>
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<tr>
<td>Khudair, 2018</td>
<td>Observational (three arms)</td>
<td>Unscreened control</td>
<td>21,632</td>
<td>7,873</td>
<td>Bowel cancer screening in Healthy study</td>
<td>61.7</td>
<td>40%</td>
<td>61%</td>
<td>12%</td>
</tr>
<tr>
<td>Bentat, 2015</td>
<td>RCT</td>
<td>Unscreened control</td>
<td>6,494</td>
<td>4.274</td>
<td>NORDCAP trial</td>
<td>52.7</td>
<td>49%</td>
<td>91%</td>
<td>71.2</td>
</tr>
<tr>
<td>Khudair, 2018</td>
<td>Observational (three arms)</td>
<td>Unscreened control</td>
<td>21,632</td>
<td>7,873</td>
<td>Bowel cancer screening in Healthy study</td>
<td>61.7</td>
<td>40%</td>
<td>61%</td>
<td>12%</td>
</tr>
</tbody>
</table>

*Multiple publications report data from the same trial. Where multiple publications are available, the study with the most comprehensive or recent data was selected. Data for the following study is excluded from the summary of results, to avoid duplication: Lassen et al., 2007

*NR = not reported
3.3.5.1 Fruits and vegetables

Changes to fruit and vegetable consumption was assessed in one RCT by two studies (Berstad et al., 2015; Larsen et al., 2007) and in four studies using observational research designs (Knudsen et al., 2018; Miles et al., 2003; Sriphanlop et al., 2018; Stevens et al., 2018). Four studies measured the mean number of portions of fruits and vegetables consumed per day (Berstad et al., 2015; Knudsen et al., 2018; Larsen et al., 2007; Miles et al., 2003). One study reported the proportion of participants consuming five or more portions of fruits and vegetables per day (Stevens et al., 2018). Another study reported the mean number of days participants consumed five or more portions of fruits and vegetables per day (Sriphanlop et al., 2018).

Most studies did not find changes in fruit and vegetable consumption following participation in bowel screening. In the NORCCAP RCT, mean servings of fruits and vegetables rose by 0.2 in the screened group and 0.3 in the control group at 11 years after FS screening (Berstad et al., 2015; Larsen et al., 2007). Similarly, there was no change in fruit and vegetable consumption one year after FS and FIT participation, compared with a 0.1 portion decrease in an unscreened comparator group (Knudsen et al., 2018). In the UK FS trial, servings of fruit increased by 0.1 and vegetables by 0.2 three months after screening participation (Miles et al., 2003), and Sriphanlop et al. (2018) reported a 0.1 increase in the number of days participants consumed at least five fruits and vegetables per week. In the English Longitudinal Study of Aging, the proportion of participants consuming five or more portions a day increased by 7.0% following FOBT participation (Stevens et al., 2018). However, similar increases were also observed in FOBT non-participants (8.1%).

3.3.5.2 Red and processed meat

Two studies from the NORCCAP RCT reported changes in meat consumption following participation in FS screening (Berstad et al., 2015; Larsen et al., 2007) and one three-armed observational study compared changes in meat consumption following FS or FIT screening with an unscreened comparator group (Knudsen et al., 2018). Two studies measured the number of servings of meat other than poultry consumed for dinner per day (Berstad et al., 2015; Larsen et
al., 2007), another study reported the number of servings of red and processed meat consumed per week.

The consumption of meat other than poultry did not change at three or eleven years after FS participation (Berstad et al., 2015; Larsen et al., 2007). In a study comparing FS and FIT participation with an unscreened comparator group, there were similar decreases in servings of red and processed meat per week in the FS (-0.1) and FIT (-0.2) and unscreened comparator groups (0.1 servings; Knudsen et al., 2018).

### 3.3.5.3 Fatty fish

Consumption of fatty fish following participation in bowel screening was reported by two studies from the NORCCAP RCT (Berstad et al., 2015; Larsen et al., 2007) and one three-armed observational study (Knudsen et al., 2018). The consumption of fatty fish was measured differently at different time points within the same trial. At three-year follow-up, participants were given a score out of six based on the frequency of consumption of fatty fish (Larsen et al., 2007). At eleven-year follow-up, Berstad et al. (2015) reported the mean number of portions of fatty fish consumed per day. Another study reported the number of servings of fatty fish per week (Knudsen et al., 2018).

In the NORCCAP trial, the frequency of consumption for fatty fish remained the same for the screened group at three-year follow-up and increased by 0.1\textsuperscript{11} for the control group (Larsen et al., 2007). At eleven years, the consumption of fatty fish increased by 0.1 at follow-up for both the screened and control groups (Berstad et al., 2015). In a study comparing fatty fish consumption in FS and FIT participants with an unscreened comparator group, consumption remained the same in the FS group, decreased by 0.1 weekly servings in the FIT group and decreased by 0.2 weekly servings in the comparator group at one-year follow-up (Knudsen et al., 2018).

\textsuperscript{11} Scored using the following criteria: 1 = Never; 2 = 1–3 times/month; 3 = 1–3 times/week; 4 = 4–6 times/week; 5 = 1–2 times/day; and 6 = >3 times per day.
3.3.5.4 Other dietary outcomes

Helander and colleagues (2017) measured changes in two composite dietary scores, between FOBT participants and a control group. The first scale was a measure of colorectal cancer-protective food consumption (CRC-P), which combined the consumption of four foods: rye bread, milk, fruits and vegetables. The second scale was a measure of colorectal cancer risk food consumption (CRC-R), which combined the consumption of four foods: processed meat, red meat, cheese and sugar. For the FOBT and control groups, the proportion of people scoring above the sex-specific median for each composite dietary score was calculated. However, it is unclear whether scores were compared with a median score for the analysed population, or for a separate reference population. At baseline, 39.7% of the FOBT group and 41.4% of the control group were above the CRC-P sex-specific median score. At follow-up, 40.2% of the FOBT group and 40.1% of the control group were above the CRC-P median score. At baseline, 38.7% of the FOBT group and 41.1% of the control group were above the CRC-R median score. At follow-up, 41.3% of the FOBT group and 42.1% of the control group were above the CRC-R median score.

3.3.6 Alcohol consumption

Three studies, all set within the context of bowel screening, measured alcohol consumption before and after participation in cancer screening (Helander et al., 2017; Knudsen et al., 2018; Stevens et al., 2018). The three studies do not provide evidence for cancer screening participation as a prompt for spontaneous changes to alcohol consumption (Figure 3.5).

Study characteristics are presented in Table 3.2. One study was an RCT of FOBT participation (Helander et al., 2017); another study was a two-arm observational study exploring FOBT participation (Stevens et al., 2018). The third study was a three-arm observational study comparing changes in health behaviours following FS or FIT participation with a matched comparator group (Knudsen et al., 2018). Helander and colleagues (2017) assessed the proportion of women consuming one or more alcoholic drinks per day, and the proportion of men consuming two or more alcoholic drinks per day. Stevens et al. (2018) used self-reported alcohol consumption data to determine the proportion of participants in each group consuming <14
alcoholic units per week. Finally, Knudsen et al. (2018) assessed the number of glasses of alcohol consumed per week.

The two studies conducted alongside FOBT screening provide conflicting accounts of alcohol consumption over time (Helander et al., 2017; Stevens et al., 2018). In one study, the proportion of people meeting alcohol consumption guidelines increased from baseline to two-year follow-up in both the FOBT (+2.0%) and control groups (+1.3%; Helander et al., 2017). In another study, the proportion of participants meeting guidelines for alcohol consumption decreased from baseline to two-year follow-up in both FOBT participants (-1.6%) and FOBT non-participants (-8.9%; Stevens et al., 2018). Differences in the study outcomes may be accounted for by the samples included in the studies. The sample used by Stevens et al. (2018) included only men, and recruited participants from a prospective cohort study, compared with the sample included by Helander et al. (2017) who were males and females and recruited via a national screening programme. A third study found a marginal reduction in the number of glasses of alcohol consumed per week in FIT participants (-0.2 glasses), and marginal increases in the FS (+0.1 glasses) and control groups (+0.2 glasses; Knudsen et al., 2018).
Figure 3.5: Summary of studies assessing changes in alcohol consumption following participation in bowel cancer screening

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Study design</th>
<th>Screening modality</th>
<th>Participants</th>
<th>Follow-up (yrs)</th>
<th>Design</th>
<th>Setting</th>
<th>Age Mean</th>
<th>Sex % male % female</th>
<th>Risk of bias</th>
<th>Participant retention %</th>
<th>Outcome measure</th>
<th>Baseline</th>
<th>Change in outcome measure from baseline</th>
<th>Change in screened group vs control group y-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heimler, 2017</td>
<td>RCT</td>
<td>FCBT-Unscreened control</td>
<td>4,035</td>
<td></td>
<td>2,287</td>
<td>2,148</td>
<td>Finnish CRC screening programme</td>
<td>60</td>
<td>44.4% 55.6%</td>
<td>HIGH</td>
<td>Proportion of women and men consuming 1 and 2 alcoholic drinks respectively each day</td>
<td>91.4</td>
<td>91.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Kompan, 2018</td>
<td>Observational (one-arm)</td>
<td>FT-Matched control</td>
<td>21,832</td>
<td>7,673</td>
<td></td>
<td></td>
<td>Bowel cancer screening in Norway study</td>
<td>61.7</td>
<td>46.8% 53.2%</td>
<td>SERIOUS</td>
<td>Glasses of alcohol per week</td>
<td>76.3</td>
<td>76.3</td>
<td>-0.1</td>
</tr>
<tr>
<td>Stavera, 2018</td>
<td>Observational (two-arm)</td>
<td>FCBT-Unscreened comparator</td>
<td>714</td>
<td>467</td>
<td></td>
<td></td>
<td>Population representative survey</td>
<td>65-81</td>
<td>100%</td>
<td>SERIOUS</td>
<td>Proportion consuming 14 or fewer alcoholic units weekly</td>
<td>63.3</td>
<td>63.3</td>
<td>-1.6</td>
</tr>
</tbody>
</table>

* Multiple publications report data from the same trial. Where multiple publications are available, the study with the most comprehensive or recent data was selected. Data for the following study is excluded from the summary of results, to avoid duplication results: Larsen et al., 2007

** N/A = not reported
3.3.7 Secondary outcomes

3.3.7.1 Weight

Changes in body weight following participation in bowel screening were assessed by three studies, all conducted within bowel screening settings (Berstad et al., 2015; Knudsen et al., 2018; Larsen et al., 2007). The three studies exploring weight change following bowel screening present conflicting results. One study reported greater weight gain in the control group three years after FS screening (Larsen et al., 2007). However, there was no difference in weight change between groups in the same sample at eleven-year follow-up (Berstad et al., 2015). One study reported greater weight loss among FS participants at two-year follow-up when compared with FIT participants (Knudsen et al., 2018). A summary of results is presented in Figure 3.6.

Study characteristics are reported in Table 3.2. Two of the studies measuring changes in weight following participation in bowel screening were conducted in the NORCCAP RCT of FS screening (Berstad et al., 2015; Larsen et al., 2007). One observational study measured changes to weight following FS or FIT screening, compared with a matched comparator group (Knudsen et al., 2018).

In the NORCCAP FS trial, the screened group had gained 0.7kg at three-year follow-up, compared with 0.4kg in the control group (Larsen et al., 2007). At eleven-year follow-up, the screened group had gained on average 1.5kg, compared with 1.4kg in the control group (Berstad et al., 2015). The authors report that the difference between groups was statistically significant at three-years, but not at 11-years. Conversely, data from an observational trial comparing FS participants, FIT participants and a comparator group report a reduction of weight in the FS (-0.6kg), FIT (-0.2) and comparator groups (-0.4kg) at follow-up (Knudsen et al., 2018). Participant retention was higher in the study which observed weight gain (screened group = 85.3%, control group = 82.2%; Larsen et al., 2007), compared with the study that observed weight loss (screened groups = 76.3%, control group = 49.9%; Knudsen et al., 2018).
### 3.6: Summary of studies assessing changes in weight and BMI following participation in bowel cancer screening

<table>
<thead>
<tr>
<th>Design</th>
<th>Baseline participant characteristics</th>
<th>Study quality</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author, year</td>
<td>Screening modality</td>
<td>Participants</td>
<td>Follow-up (years)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Per arm</td>
</tr>
<tr>
<td>Deindt, 2015</td>
<td>RCT</td>
<td>FS</td>
<td>Unscreened control</td>
</tr>
<tr>
<td>Kroesen, 2018</td>
<td>Observational follow-up</td>
<td>FS</td>
<td>Unscreened control</td>
</tr>
<tr>
<td>Helander, 2017</td>
<td>RCT</td>
<td>POBT</td>
<td>Unscreened control</td>
</tr>
<tr>
<td>Larsen, 2009</td>
<td>RCT</td>
<td>FS</td>
<td>Unscreened control</td>
</tr>
</tbody>
</table>

*Multiple publications report data from the same trial. Where multiple publications are available, the study with the most comprehensive or recent data was selected. Data for the following study is excluded from the summary of results to avoid duplication results. Larsen et al., 2007.
3.3.7.2 BMI

BMI was assessed before and after bowel screening in three studies, including two RCTs (Helander et al., 2017; Larsen et al., 2007), and one observational study conducted alongside FS screening (Hoff et al., 2001). The available data do not support cancer screening as a prompt for changes in BMI. A summary of the results is presented in Figure 3.6. Study characteristics are presented in Table 3.2.

Data from the NORCCAP FS trial indicated that BMI increased by 0.2 in the screened group and 0.2 in the control group at three-year follow-up (Larsen et al., 2007). An observational study also explored changes in BMI following FS screening (Hoff et al., 2001). Limited information about BMI following FS was presented in the paper, including an increase in BMI of 0.7 among men and 1.3 among women in the sample. The authors report no difference in BMI between the screening group (25.1) and the control group (25.2) at 13-year follow-up. In a third study, FOBT participants were compared with a control group (Helander et al., 2017). The proportion of participants with a BMI equal to or lower than 25 decreased in both the screened (-2.5%) and control groups (-1.0%).

3.3.7.3 Adiposity

None of the identified studies measured changes in adiposity before and after participation in cancer screening.

3.3.8 Meta-analysis of results

We had aimed to do a meta-analysis for each health behaviour. However, this was not possible for a number of reasons. Firstly, a meta-analysis of observational data may provide a false account of behaviour change following cancer screening. For example, all of the observational studies reporting changes in smoking following lung screening reported a positive effect of screening. However, the data from RCTs is largely inconsistent with this, making it difficult to determine the true effect of screening on smoking in observational studies without comparator groups. Just three observational studies, set within the context of bowel screening, included comparator groups (Hoff et al., 2001; Stevens et al., 2018) (Knudsen et al., 2018), and one of these studies did not provide the required data for meta-analysis (Hoff et al., 2001).
The included studies have a high degree of methodological heterogeneity (Higgins et al., 2008). Firstly, the heterogeneity between screening programmes (lung and bowel) means that studies set within the two programmes cannot be compared directly. There is also heterogeneity in the screening modalities used within each programme. For example, within bowel screening programmes multiple modalities were reported including FS (Berstad et al., 2015; Knudsen et al., 2018; Larsen et al., 2007; Miles et al., 2003), FIT (Knudsen et al., 2018), FOBT (Helander et al., 2017; Stevens et al., 2018) and colonoscopy (Sriphanlop et al., 2018). Guidelines for managing heterogeneity for meta-analysis advise each exposure should be analysed separately (Higgins et al., 2008). There are few studies reporting the same exposure, limiting the practicality of meta-analysis for the included studies.

The differences in samples included in studies also introduce heterogeneity. For example, some studies included male-only samples (Shi & Iguchi, 2011; Stevens et al., 2018; van der Aalst, van den Bergh, et al., 2010; van der Aalst et al., 2011). Another example of heterogeneity in study samples is related to whether studies assessing smoking cessation include baseline non-smokers in their samples. This issue is only applicable to lung screening settings, where some studies included non-smokers (e.g. Ashraf et al., 2014) in their baseline samples and others did not (e.g. Brain et al., 2017). Estimates of smoking differ between these two study types, as studies that include baseline non-smokers also take into account smoking relapse. This means results from studies that include non-smokers in their analyses cannot be pooled with results from studies that include only smokers at baseline.

Finally, differences in outcome measures and follow-up periods make it difficult to pool the results of studies reporting on the same outcomes. An example of this is dietary outcomes where seven separate outcomes were assessed across seven studies (Berstad et al., 2015; Helander et al., 2017; Knudsen et al., 2018; Larsen et al., 2007; Miles et al., 2003; Sriphanlop et al., 2018; Stevens et al., 2018). Single outcomes (such as fruit and vegetable consumption) were assessed differently across multiple studies meaning that pooling of results was not possible. For example, Stevens et al., (2018) assessed the proportion of people meeting English guidelines for fruit and vegetable consumption, other studies reported the mean number of portions consumed per day.
(Knudsen et al., 2018; Larsen et al., 2007; Miles et al., 2003), and one study reported the mean number of days that participants consumed five or more portions of fruits and vegetables (Sriphanlop et al., 2018). Similarly, a wide range of definitions of smoking abstinence were adopted by studies exploring smoking cessation following cancer screening, for example, four-week point prevalent abstinence (Ashraf et al., 2014; Ashraf et al., 2009), 30-day point prevalent abstinence (Barry et al., 2012).

### 3.3.9 Risk of bias

A summary of risk of bias ratings for RCTs is presented in Figure 3.7. Within the RCTs, two studies from the same trial of LDCT lung screening were rated as low risk of bias (Ashraf et al., 2014; Ashraf et al., 2009). Three studies scored high for risk of bias (Barry et al., 2012; Helander et al., 2017; Larsen et al., 2007). Two of three of the RCTs conducted within bowel screening settings were rated as high risk of bias (Helander et al., 2017; Larsen et al., 2007), highlighting the need to conduct high-quality research within the context of bowel cancer screening. The most common reason for a study to be rated as high risk of bias was due to bias in the measurement of the outcome. Most studies did not include objective measures of outcome variables (e.g. Helander et al. 2017), and some studies included outcome measures that were not sensitive to change (e.g. Berstad et al. 2015). One study even changed the way that smokers were categorised between baseline and follow-up measures (Barry et al., 2012). Another common reason for high risk of bias was due to high levels of missing data in the outcome variable (e.g. Helander et al. 2017).

A summary of risk of bias ratings for observational studies is presented in Figure 3.8. Of the 20 observational studies included in this review, just three were rated as low risk of bias (Kaufman et al., 2018; Styn et al., 2009; Townsend et al., 2005). Six studies were rated as high risk of bias (Hoff et al., 2001; Knudsen et al., 2018; MacRedmond et al., 2006; Miles et al., 2003; Schnoll et al., 2002; Sriphanlop et al., 2018; Stevens et al., 2018). Four of the five studies conducted within bowel screening settings were rated as high risk of bias (Hoff et al., 2001; Knudsen et al., 2018; Miles et al., 2003; Schnoll et al., 2002; Sriphanlop et al., 2018; Stevens et al., 2018). As with the RCTs, many studies were biased in their measurement of the outcome and had issues regarding levels of missing data. In addition, some studies were rated as high risk of bias due to the selection
of participants into the study. For example, in the study by Schnoll and colleagues (2002), participants, only 33% of eligible participants enrolled in the study.

Figure 3.7 Risk of bias in included studies: randomised controlled trials
Figure 3.8 Risk of bias in included studies: observational studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Bias due to confounding</th>
<th>Bias in the selection of participants into the study</th>
<th>Bias in the classification of interventions</th>
<th>Bias due to deviations from the intended interventions</th>
<th>Bias due to missing outcome data</th>
<th>Bias in the measurement of the outcome</th>
<th>Bias in the selection of the reported result</th>
<th>Overall risk of bias</th>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
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<td>Borondy Kitts et al., 2016</td>
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<td>✓</td>
<td>✓</td>
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<tr>
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<tr>
<td>Kumar et al., 2016</td>
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<td>✓</td>
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<tr>
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- Low risk of bias
- Moderate risk of bias
- Serious or critical risk of bias
- No information
3.3.10 Departures from pre-registered protocol

Two additional review questions were outlined in the protocol: Does invitation to participate in cancer screening lead to spontaneous changes to cancer-related health behaviours (smoking, alcohol consumption, physical activity, diet, body weight, BMI)? And, if spontaneous health behaviour change does occur following invitation to participate in cancer screening, is it in a positive or negative direction? Due to a large number of studies identified relating to the primary research questions, this thesis chapter did not attempt to answer these secondary questions.

One factor that was not considered when writing the protocol was the almost ubiquitous provision of smoking cessation advice alongside lung cancer screening programmes. The protocol stated that studies reporting interventions to change health behaviours in the screening context would be excluded. In the course of the review, a pragmatic approach was taken to include studies measuring smoking cessation alongside lung screening, even where smoking cessation advice was delivered alongside screening. However, studies explicitly testing the efficacy of smoking cessation interventions alongside screening were excluded from the review.

3.4 Discussion

This review sought to address the first aim of this thesis, to explore whether participation in cancer screening programmes prompts spontaneous changes to health behaviours. Twenty-nine studies were identified. While many studies reported changes to health behaviours following cancer screening, results from RCTs and observational studies could lead to different conclusions. Most studies which included control or non-screened comparator groups found equal rates of change between groups. Therefore, the available evidence does not support the hypothesis that cancer screening is a teachable moment for spontaneous change. An important caveat to this is that research was extremely limited for some outcomes (e.g. alcohol consumption) and non-existent for two screening modalities (breast and cervical). While the results of this review do not support the suggestion of screening as a prompt for spontaneous positive health behaviour change, reassuringly there was little evidence of a health certificate effect at screening.

The primary research question of this review was to assess whether breast, bowel, cervical or lung cancer screening leads to spontaneous changes in cancer-related health behaviours. The
most commonly assessed outcome was smoking cessation (k=28). All studies reported reductions in smoking over time. However, the data from RCTs generally did not attribute reductions in rates of smoking to cancer screening participation. Rates of cessation appeared to be highest in studies conducted in lung screening settings. For example, one study with a two-year follow-up reported a 1.0% reduction in smoking rates among FOBT participants (Helander et al., 2017), compared with a 15.1% reduction among LDCT participants at two-year follow-up (van der Aalst, van den Bergh, et al., 2010). However, baseline rates of smoking were higher in almost all studies conducted in lung screening settings, as smoking status and smoking history comprise a key component of lung screening eligibility criteria. The one lung screening RCT that did not include smoking status in its screening criteria had the lowest rates of smoking at baseline (~18%) and the lowest rates of change at long-term follow-up (~4% reduction in both study arms; Barry et al., 2012). Studies generally reported greater rates of smoking cessation than would be expected in the general population (NHS Digital, 2018b). However, the populations in the included studies are not likely to be representative of the general population in terms of smoking behaviour, particularly for trials of lung screening programmes. Therefore, comparisons between rates of cessation in these studies and rates of cessation in the general population are problematic.

A similar picture emerged for physical activity, where two observational studies reported positive changes to behaviour in the time following bowel screening participation (Miles et al., 2003; Stevens et al., 2018). However, RCTs did not find greater change among screening participants when compared to controls. A range of research designs were used to assess physical activity within bowel screening settings. As well as RCTs, studies used prospective cohort data (Stevens et al., 2018), and compared multiple bowel screening modalities with a matched control group (Knudsen et al., 2018). Despite a greater range of research designs, the risk of bias in five of the seven studies was high. A contributing factor to this is the use of self-report measures that may not be sensitive to change. For example, one observational study asked participants whether they were taking ‘regular exercise’ each week (Miles et al., 2003). Therefore, the evidence currently available does not support bowel cancer screening as a teachable moment for spontaneous changes to physical activity. Rates of physical activity decline with age (Sport England, 2019).
However, most studies did not find a reduction in rates of physical activity over time, indicating that the samples may not reflect the general population.

The most commonly assessed dietary outcome was fruit and vegetable intake, which was measured by six studies in the context of bowel cancer screening. One RCT found that increases in fruit and vegetable consumption were greater in the control group at three-year follow-up (Larsen et al., 2007). However, eleven-year follow-up from the same trial (Berstad et al., 2015) and all other studies did not find bowel cancer screening to be a prompt for changes to fruit and vegetable consumption. Few studies explored other dietary outcomes, such as red and processed meat consumption, or other outcomes such as alcohol consumption, weight and BMI. Therefore, it is not possible to conclude whether cancer screening is a prompt for spontaneous behaviour change for most outcomes.

It is important to consider the differences between bowel and lung cancer screening programmes when assessing the impact of cancer screening on health behaviours. Firstly, the screening programmes differ in their eligibility criteria. Bowel cancer screening is a true population screening programme, where all members of a population will be invited to participate when they reach the target age range. Lung screening programmes employ risk-based eligibility criteria, meaning that most of the general population will not be eligible to participate. The key difference this makes to the interpretation of results lies in the behavioural profile of the samples. For example, more than half of lung screening invitees will be smokers (Joseph et al., 2018). Therefore, rates of smoking will be considerably higher in lung screening samples compared with bowel screening samples. This was evident in the results of this review, where rates of smoking, and consequently, rates of smoking reduction, were greater in studies set within lung screening programmes. A second consideration when comparing results of studies set within bowel and lung screening settings is the provision of smoking cessation in some lung screening settings. This is in line with recommendations by screening committees (e.g. Oudkerk et al., 2017) to provide smoking cessation advice to lung screening attendees. There is no equivalent advice for bowel screening settings. Therefore, the interpretation of whether any observed behaviour change in lung screening settings is truly spontaneous is called into question.
The secondary research question was to determine whether behaviour change occurs that following cancer screening was in a positive or negative direction. Given the lack of evidence that any substantial changes to health behaviours follow participation in cancer screening, this additional research question is largely moot. Previous concerns have been raised about cancer screening resulting in a health certificate effect, suggesting that behaviour change may be inhibited among screening attendees who receive negative results (Cooper et al., 2017). Indeed, this effect was reported in one randomised trial of lung screening (van der Aalst, van den Bergh, et al., 2010). The study reported increased rates of smoking cessation among control group participants. However, other RCTs within this context did not report the same effect (Ashraf et al., 2014; Barry et al., 2012; Shi & Iguchi, 2011), and one study even reported increased rates of smoking cessation in screened participants (Brain et al., 2017). Overall, the studies identified in this review do not suggest a health certificate effect of screening.

The evidence presented in this review is in line with previous reviews which have not found cancer screening to be a teachable moment for health behaviour change (Deutekom et al., 2011; Slatore et al., 2014; van der Aalst, van Klaveren, et al., 2010). However, there are still a number of important gaps in the literature. No studies set within breast and cervical screening programmes were identified in this review. Therefore, it is still unknown whether breast and cervical screening serve as a teachable moment for spontaneous behaviour change. It is important for future research to address this issue, as more than 2 million women participated in the English breast screening programme in 2017-18 (NHS Digital, 2019a) and more than 3 million women participated in the English cervical screening programme in the same period (NHS Digital, 2018a). The lack of research in this field was highlighted in a review in 2003, with no research exploring this effect published in the intervening period (Bankhead et al., 2003). It is essential to consider why research has not explored the impact of breast and cervical screening on health behaviour. One reason might be that it is difficult to randomise women to screening and control groups where screening programmes are already implemented. Breast and cervical screening programmes were first implemented in England in the 1980s, providing limited opportunities to conduct RCTs with these populations. Despite this, there are opportunities for conducting other kinds of research in these settings. For example, trials of new screening modalities (such as HPV primary testing).
and pathways in breast and cervical screening programmes may provide opportunities to test the teachable moment hypothesis. In addition, observational research with screening non-participants used as a comparator group may provide information about the impact of screening in non-trial settings (Stevens et al., 2018).

Furthermore, future research should consider a range of behavioural outcomes across screening programmes. No studies explored the impact of cancer screening on adiposity. All but one studies included in the review measured smoking before and after screening attendance. Moreover, in the context of lung screening, smoking was the only behaviour to be assessed. Studies in the context of bowel screening programmes took a broader view of health behaviour change at screening, with all studies measuring more than one health behaviour pre and post-screening. This is likely a result of evidence linking specific cancer risk factors with individual cancer types. However, literature exploring clustering of health behaviours suggests health behaviours do not always occur in isolation (Meader et al., 2016; Noble et al., 2015). For example, the high proportion of smokers attending lung screening programmes may mean that this population also engage in other cancer risk increasing behaviours, such as excessive alcohol consumption. It is not known how important the link is between the behaviour in question and the cancer that is being screened for. This is likely to depend on peoples understanding of cancer risk factors (Cancer Research UK, 2016).

There was a high degree of methodological heterogeneity between studies. Therefore, there are a number of methodological issues to consider when attempting to determine the impact of screening participation on health behaviour, including research design and the measurement of outcomes. Most studies exploring behaviour change within existing screening programmes used single-armed observational research designs. Observational research designs may be more feasible within existing screening programmes as they do not involve manipulation of screening participation. However, without suitable comparator groups it is difficult to attribute behaviour change directly to cancer screening participation. Most RCTs were conducted within trial settings. Screening trials offer the opportunity to compare screened populations with control groups in RCTs without disrupting set screening protocols within existing programmes. While RCTs are
considered the gold standard of determining cause and effect, this research design does not come without limitations. For example, one issue with assessing behaviour change within trials of screening is that the participants may not be representative of screening participants in real-world screening programmes (Hestbech, Siersma, Dirksen, Pedersen, & Brodersen, 2011).

It is also important to consider the way in which outcomes are measured in the context of cancer screening. There was variation in the measurement, categorisation and reporting of health behaviour in the included studies across all outcomes, except for weight. All outcomes were self-reported, apart from a small number of studies which reported using biochemical verification of smoking within their samples (Ashraf et al., 2014; Ashraf et al., 2009; Cox et al., 2003). Objective measures of health behaviour are not always possible for all outcomes, such as diet. However, where possible, measures less susceptible to the biases of self-report should be considered. For example, changes in physical activity can be measured using accelerometers.

As well as some measures lacking objectivity, some were not sensitive to change, making conclusions about the impact of screening on health behaviour impossible. For example, Stevens and colleagues (2018) assessed the proportion of participants taking part in moderate or vigorous physical activity once or more per week. It is possible that participants could have increased or decreased their levels of physical activity without a change in their broad categorisation of physical activity. One study even changed the measures used to categorise smoking status part way through their study. In order to understand whether behaviour change occurs following participation in cancer screening, it is essential to use appropriate measures that are sensitive to change. There is some consensus on how smoking cessation should be measured within trials (West, Hajek, Stead, & Stapleton, 2005). However, this is not always followed, and consensus on measuring other behavioural outcomes (such as diet) has not yet been reached.

Related to the measures used to assess outcomes is the timeliness of measurement. Within the studies included in this review, the length of follow-up ranged from two weeks to 13 years. One study had suggestive evidence of a positive effect of screening on smoking rates. However, ITT and complete case analyses differed, with statistically significant differences observed at two weeks in both analyses, but only at 2 years in ITT analyses (Brain et al., 2017). Similarly, within
a bowel screening context, one study found greater rates of smoking cessation in the control
group at three years; however, this effect was not present at 11 years (Berstad et al., 2015; Larsen
et al., 2007). This indicates that there may be important short-term changes to health behaviours
that are overlooked by studies without follow-up period close to the screening appointment. It is
important to understand how to capitalise on small changes made following screening, and to
understand whether motivation to engage in behaviour change interventions occurs at this time,
regardless of spontaneous behaviour change.

3.4.1 Strengths
This systematic review provides an updated account of literature exploring cancer screening as
a teachable moment for health behaviour change. More than half of the studies (k=16) included
in this review were published since the first reviews were published on this topic in 2010 and 2011
(Deutekom et al., 2011; van der Aalst, van Klaveren, et al., 2010). This review not only updated
previous reviews on this topic, but also used two quantitative research designs, and included an
extensive range of behavioural cancer risk factors as outcomes.

Another strength of this review is the methodological rigour of the study selection and data
extraction processes. Two reviewers were involved in the abstract and full-text review stages
when identifying eligible studies. In addition, a second reviewer checked the data extraction forms
for all included studies.

3.4.2 Limitations
There are a number of limitations to this systematic review. Eight of the studies included in the
review were identified through forward and backward citation searches. This suggests that the
search strategy could benefit from refinement. The current search required studies to include
terms relating to cancer screening, behaviour change and teachable moments within their title
abstract or keywords. This yielded 5,642 results. If the search was broadened so that articles
need only include a term relating to cancer screening plus a term about either behaviour change
or teachable moments, 93,438 results would have been identified within the OVID databases
alone. A pragmatic decision was made due to time constraints to limit the search. Therefore, it is
possible that this review did not identify all of the relevant literature. Another limitation related to
Chapter 3. Spontaneous behaviour change following cancer screening: systematic review

the identification of studies is that only 10% of titles were screened by two reviewers, although agreement was high.

The decision to include studies which included a smoking cessation component is another limitation of this review. Of the 21 studies exploring smoking cessation at lung screening, 13 explicitly mentioned the provision of smoking cessation advice or information. A further five studies did not mention the provision of advice but were conducted within trials where other studies have reported that advice is delivered. These studies were kept in the review, as they were not explicitly testing interventions to promote smoking cessation. Rather, the provision of advice was in line with recommendations for the implementation of lung screening programmes (Oudkerk et al., 2017; U.S. Preventive Services Task Force, 2016). This decision was made to reflect the way that screening programmes are currently delivered in practice. The effectiveness of smoking cessation advice delivered in the context of lung screening was the focus of a recent systematic review (Pineiro, Simmons, Palmer, Correa, & Brandon, 2016). Limited research has been conducted within this emerging field, and currently, there is little consensus about the most effective way to deliver smoking cessation advice at lung screening. It is of note that none of the studies exploring behaviour change at bowel screening reported lifestyle advice being delivered as part of the usual screening protocol, although limited information on behavioural risk factors is currently available within standard NHS bowel screening leaflets.

Finally, a number of the studies included in this review explored the impact of screening results on health behaviour change (Tammemagi et al., 2014). A previous review of smoking cessation in the context of lung cancer screening suggested that screening results might play a role in the extent to which people change their behaviour following cancer screening participation (Pineiro et al., 2016). The role of screening results on health behaviour was outside the scope of this review but may provide valuable insight into cancer screening as a teachable moment for health behaviour change.

3.4.3 Conclusions

The studies included in this review do not provide convincing support for cancer screening as a prompt for spontaneous health behaviour change. However, this review highlights a number of...
critical research gaps. The majority of research conducted to date has been observational, without the inclusion of unscreened comparator groups. Furthermore, there has been no research within breast and cervical cancer screening contexts, and a lack of research for many behavioural outcomes. Finally, at the time of the initial search there had been no research conducted within established NHS cancer screening programmes. Following an initial literature search, it was apparent that more robust research with suitable comparator groups was needed. The following chapter (Chapter 4, Study 2), describes a study designed to address some of the issues faced when exploring cancer screening as a prompt for spontaneous health behaviour change.
Chapter 3. Spontaneous behaviour change following cancer screening: systematic review
Chapter 4. Lifestyle changes associated with participation in colorectal cancer screening: Prospective data from the English Longitudinal Study of Ageing (Study 2)

4.1 Introduction

The systematic review presented in Chapter 3 identified eight studies exploring spontaneous health behaviour change following participation in bowel cancer screening, including a published version of this chapter (Study 2). While some studies observed changes to behavioural outcomes following participation in bowel cancer screening, methodological constraints limit firm conclusions about the impact of screening on health behaviour. Following the initial search as part of the systematic review, no studies were identified that included a comparator group within English cancer screening programmes. This study was designed to address this research gap and employed a novel methodological approach to explore bowel cancer screening as a prompt for spontaneous health behaviour change.

As outlined in Chapter 3, there are many challenges in observing the effect of cancer screening participation on health behaviour. Within existing screening programmes it may not be practicable or appropriate to conduct RCTs. Consequently, just three studies have used this design, all within trials of new bowel screening modalities (Berstad et al., 2015; Helander et al., 2017; Larsen et al., 2007). One of these studies, set within the Norwegian Colorectal Cancer Screening Prevention trial, suggests FS participation may result in a health certificate effect (Larsen et al., 2007). However, the negative effects of cancer screening participation were modest and were not sustained at eleven-year follow-up (Berstad et al., 2015).

Uniquely, the study by Helander and colleagues (2018) included analyses of screening non-participants from the ‘invited to screening’ condition. Analyses compared the invited sample (those who participated in FOBT plus those who did not participate) with the control group; there were no differences in change scores between the invited group (OR 0.80, 95% CI 0.72-0.90) and the control group (OR 0.80, 95% CI 0.71-0.90), or between screening participants (OR 0.81, CI 0.72–0.92) and screening non-participants (OR 0.75, CI 0.55–1.03) at one-year follow-up. However, rates of screening participation were high among the invited sample (86%). Participation in trials of bowel screening programmes may be higher than in subsequently established screening programmes, which is important when interpreting the results of studies conducted in trial settings (Koo, Neilson, Von Wagner, & Rees, 2017). Distinguishing between screening participants and non-participants in analyses may present a more accurate reflection of behaviour change following screening. The study by Helander et al., (2018) was the only study to take this approach to date; it is, therefore, essential to determine whether the null findings are replicated within different samples.

While studies using randomised controlled designs are considered the most robust, it is not possible to replicate the results of these trials within existing screening programmes. Therefore, to examine health behaviour change within the English Bowel Screening Programme, it is necessary to use observational methodologies. To date, no research has explored health behaviour change within the English Bowel Screening Programme. However, as described in Chapter 3, one study explored changes in health behaviours following participation in the UK FS trial (Miles et al., 2003). Baseline and three-month follow-up data were available for 3,535 adults who took part in the trial. The authors report a significant decrease in smoking following FS participation (OR 0.67, 95% CI 0.46-0.98). At baseline, 14.1% of the sample were smokers, compared with 13.4% the sample three months later. An increase in fruit and vegetable intake (Fruit F(13, 445) = 41.4 P<0.001; vegetables F(13,435) = 17.5, P<0.001) and exercise are also reported (OR 1.91, 95% CI 1.62-2.25). Surveying only screening attendees makes it difficult to confirm whether changes in health behaviour are as a result of screening participation. This is particularly relevant for smoking cessation, where smoking is decreasing at a population level (NHS Digital, 2018b). As a result, pre-post studies are likely to observe decreases in rates of
smoking regardless of an intervention or exposure. While observational studies without comparator groups may signal potentially important trends in health behaviour following bowel screening, it is impossible to attribute behaviour change to screening participation.

One way of overcoming some of the issues of single-arm observational research is to identify ways of observing non-randomised groups of screening participants and non-participants, using non-participants as a comparator group. While non-randomised studies do not fully overcome the limitations of single-arm observational research, this research design has the potential to reflect how behaviour naturally changes over time for screening participants compared with screening non-participants.

Prospective cohort studies may provide opportunities to assess the impact of possible teachable moments, such as cancer screening, by including data for exposed and unexposed groups. This research design has been used to explore the effects of other health-related and life events on health behaviours. A study of 5,146 adults in the English Longitudinal Study of Ageing (ELSA) was used to determine whether behaviour change occurred following a diagnosis of cancer (Williams, Steptoe, & Wardle, 2013). Around 8% of the sample had received a diagnosis of cancer. This group were compared to participants who did not receive a cancer diagnosis for smoking, alcohol consumption and physical activity. The two groups differed in their levels of physical activity, with the group who had received a cancer diagnosis less likely to be physically active and more likely to be sedentary. The proportion of smokers reduced across both groups over time, as did the proportion of participants who consumed alcohol daily. However, crucially, there were no differences in the magnitude of these changes between the groups, suggesting that a diagnosis of cancer did not appear to trigger health behaviour change post-diagnosis.

More recently, the same approach was used to investigate changes to health behaviour following a diagnosis of type 2 diabetes (Hackett, Moore, Steptoe, & Lassale, 2018). The sample included 368 participants with type 2 diabetes and 6,509 without. Data for smoking, alcohol consumption, physical activity, sedentary behaviour and fruit and vegetable intake were analysed prior to their diagnosis, at the time of diagnosis and two years after their diagnosis. Participants who received a diagnosis of type 2 diabetes were less likely to participate in weekly moderate or vigorous
physical activity; this group were also less likely to consume daily alcohol than the comparator
group. For both groups, smoking, alcohol consumption and physical activity decreased over time.
Participants who received a diagnosis of type 2 diabetes were more likely to quit smoking than
the comparator group. No differences in rates of behaviour change were observed for the other
outcomes. These results suggest a diagnosis of type 2 diabetes could be a teachable moment
for smoking cessation.

This methodology has not yet been used to explore cancer screening as a teachable moment for
behaviour change. The ELSA provides a novel opportunity to understand health behaviour
change following participation in an NHS Bowel Screening Programme. There are several
advantages to using data from a prospective cohort study. Firstly, it is possible to compare
screening participants with a comparator group of screening non-participants. In addition, it
makes it possible to select participants receiving their first invitation to a cancer screening
programme. This is important because the impact of screening participation on health behaviour
may differ depending on prior screening experience, as observed within a cardiovascular
screening setting (Bretteville-Jensen, Børn, & Selmer, 2014). The ELSA sample affords the
opportunity to select a sample of men invited to participate in FOBT for the first time. Prior to the
recent implementation of flexible sigmoidoscopy screening, men received their first invitation to a
National Health Service (NHS) cancer screening programme (FOBT) at the age of 60. In
comparison, by the age of 60, women will have received multiple invitations to participate in
cervical and breast screening, so the decision was made to focus on men.

To address the first aim of this thesis, study 2 sought to investigate whether participation in FOBT
screening prompts spontaneous health behaviour change using prospective cohort data. This
study was the first to explore an established NHS bowel screening programme as a teachable
moment for spontaneous health behaviour change outside of a trial setting. Furthermore, this is
the first research to use prospective cohort data to explore behaviour change at bowel screening
in screening participants and non-participants.
Chapter 4. Lifestyle change associated with FOBT participation

4.1.1 Aim
The aim of this research was to determine whether first participation in the English NHS FOBT cancer screening programme prompts spontaneous health behaviour change, in a screening naïve population of men from a prospective cohort study in England.

4.2 Methods

4.2.1 Design
Data were from the ELSA, a biennial prospective cohort study of English adults aged over 50. The cohort was originally sampled from the Health Survey for England, with refreshment samples recruited to maintain adequate sample size and representativeness (Steptoe, Breeze, Banks, & Nazroo, 2013). Data are collected for a range of health, social, wellbeing and economic outcomes. Data are collected using computer-assisted personal interviews and self-complete questionnaires. The data presented in this chapter are from four waves of data collection (wave 4, 2008/2009 – wave 7, 2014/2015).

4.2.2 Participants
Men approaching the age of their first invitation to participate in FOBT were included in analyses. FOBT is offered biennially, via a postal home-test kit, to men and women aged 60-74, who receive their first invitation to participate shortly after their 60th birthday. Prior to the postal home-test kit, participants receive an invitation letter with a leaflet explaining the test. The leaflet highlights weight, lack of exercise, and dietary factors as bowel cancer risk factors. The home-test kit involves providing three sets of stool samples over a ten-day period.

To identify participants approaching the age of their first FOBT invitation, participants’ baseline data (prior to their first invitation) were taken from the wave at which they were aged 57-59. Three waves of data were used to identify baseline groups: wave four (2008-2009; n=210), wave five (2010-2011; n=280) and wave six (2012-2013; n=284; total n=774). Wave four included fewer participants as questions relating to FOBT were included part-way through data collection. The next consecutive wave of data for each participant (waves five, six and seven respectively)
provided follow-up data (following first FOBT invitation). At follow-up, participants were aged 60-61.

4.2.3 Exclusion criteria
Participants outside of age 57-59 at baseline and 60-61 were excluded from the analyses to ensure they had been invited to participate in FOBT once only. Participants who reported a diagnosis of cancer at either time-point were excluded.

4.2.4 Measures
A copy of the measures administered as part of ELSA is included in Appendix C.

*FOBT participation:* Participation in FOBT was defined as answering ‘yes’ to the question ‘Have you ever completed the NHS bowel cancer screening test using the home test kit?’ This question was included as part of the computer-assisted personal interview. This variable was added to the ELSA partway through the fifth wave of data collection.

*Demographic variables:* Data for ethnicity, education, and occupation were taken from a person’s baseline wave and were recorded as part of the computer-assisted personal interview. Ethnicity was categorised as white and non-white, due to the limited number of participants who were recorded as an ethnicity other than white. For example, 1.08% of the sample were recorded as Black or Black British. Based on the highest level of educational qualification achieved, education was categorised into no formal qualifications (no qualification), qualifications below degree level (NVQ levels 1-3, O-level, A-level or equivalent), and education at degree level or above (NVQ levels 4 and 5, university degree). Occupation was categorised into managerial or professional, intermediate, routine or manual, and other. Baseline and follow-up data were used for demographic variables likely to change over time. For retirement status, participants were categorised as retired or not retired at each time-point. Participants were asked whether they had a long-standing illness (yes/no), and whether it was life-limiting (yes/no); used to categorise participants as having a long-standing illness which was life-limiting or not.
Chapter 4. Lifestyle change associated with FOBT participation

**Smoking:** Participants were categorised as current smokers if they answered ‘yes’ to the question ‘Do you smoke at all nowadays?’ This measure was included in the computer-assisted personal interview.

**Alcohol consumption:** Participants were asked to record the number of measures of 1) spirits, 2) glasses of wine, and 3) pints of beer, lager, or cider they had consumed in the past week (e.g. “During the last seven days, how many measures of spirits did you have? Drinks poured at home may be larger than a pub single measure – please estimate number of singles.”) This data was coded based on standard measures of alcoholic units within each category of alcoholic drink (single measure of spirits = 1 unit; one regular beer, lager and cider = 2 units, medium glass of wine (2.1 units; Department of Health, 2013). Based on NHS guidelines for alcohol consumption, participants were categorised as meeting guidelines for alcohol consumption if they had consumed 14 or fewer alcoholic units in the past week (Department of Health, 2016). These measures were included in the self-complete questionnaire.

**Fruit and vegetable consumption:** From wave five onwards, two items from the self-complete questionnaire assessed fruit and vegetable consumption; ‘How many portions of vegetables – excluding potatoes – do you eat on a typical day?’ and ‘How many portions of fruit – of any kind – do you eat on a typical day?’ For each measure, guidance was given on standard portion sizes. Responses were combined to create a composite measure of fruit and vegetable consumption. Participants who consumed five or more portions each day were categorised as meeting UK guidelines (Public Health England, 2017). Different, non-comparable items were used prior to wave 5, meaning analyses of this variable used a reduced sample.

**Physical activity:** Levels of moderate (MPA) and vigorous physical activity (VPA) were assessed using two variants of the same item: ‘Do you take part in any sports or activities that are (vigorous/moderately energetic)’ with response options of ‘more than once a week’, ‘once a week’, ‘one to three times a month’, ‘hardly ever or never’. The response options ‘more than once a week’ and ‘once a week’ were combined to determine the proportion of people participating in VPA and MPA once or more per week. UK PA guidelines advise adults should participate in at least 150 minutes of MPA or 75 minutes of VPA per week (Department of Health, 2011a).
4.2.5 Analyses

Data were described using means and proportions. Multivariate logistic regression was used to determine demographic predictors of FOBT participation. To investigate the effect of FOBT participation on the lifestyle factors, five separate generalised estimating equations (GEE) were used. GEE is a method used to analyse longitudinal data allowing for the estimation of differences between groups (FOBT participants vs non-participants) for an outcome, changes in an outcome over time, and group by time interactions (Hanley, Negassa, Edwardes, & Forrester, 2003). Each GEE model included two main effects (group, time) and an interaction effect (group*time), and was adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status, and baseline wave. The main effect for time shows whether, across the whole sample, lifestyle factors changed between baseline and follow-up. The main effect for group shows whether, across both time points, there are any differences between groups (FOBT participants / FOBT non-participants). The interaction effect assesses whether FOBT participants changed their behaviour to a greater or lesser degree than FOBT non-participants. Proportions reported alongside GEE analyses are adjusted for ethnicity, occupation, education, limiting long-standing illness and retirement status. Statistical analyses were carried out in Stata SE 14.

4.3 Results

The total sample size was 774. Approximately one-third of participants were selected from each baseline wave (wave 4 = 210, wave 5 = 280, wave 6 = 284). Of the sample (n=774), almost two-thirds (62.5%, n=484) reported participating in FOBT at follow-up. Most of the sample were white (95.1%, n=736), and one quarter (27.7%, n=213) were educated to degree level or above (table 4.1). Among those who were employed, almost half (46.7%, n=345) were employed in managerial and professional occupations. A quarter reported having a life-limiting long-standing illness at baseline (24.3%, n=184) and follow-up (24.4%, n=189). Rates of retirement increased from 12.5% (n=95) at baseline to 24.3% (n=188) at follow-up. Multivariate logistic regression, including baseline and follow-up demographic characteristics, revealed that retirement status at follow-up was positively associated with FOBT participation (OR 1.99, 95% CI 1.25-3.15, p=0.003). No other demographic factors were associated with FOBT participation.
Table 4.1 Demographic characteristics of the total sample, FOBT participants and non-participants, with multivariate analyses to identify demographic predictors of FOBT participation

<table>
<thead>
<tr>
<th></th>
<th>Total sample % (n)</th>
<th>FOBT participants % (n)</th>
<th>FOBT non-participants % (n)</th>
<th>Adjusted odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity (n=774)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>95.1 (736)</td>
<td>94.0 (460)</td>
<td>95.2 (276)</td>
<td>REF</td>
</tr>
<tr>
<td>Non-White</td>
<td>4.9 (38)</td>
<td>5.0 (24)</td>
<td>4.8 (14)</td>
<td>1.17 (0.57-2.43)</td>
</tr>
<tr>
<td><strong>Baseline education (n=770)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree level or above</td>
<td>27.7 (213)</td>
<td>30.9 (149)</td>
<td>22.2 (64)</td>
<td>REF</td>
</tr>
<tr>
<td>Qualifications below degree</td>
<td>58.4 (450)</td>
<td>56.4 (272)</td>
<td>61.8 (178)</td>
<td>0.77 (0.51-1.16)</td>
</tr>
<tr>
<td>No formal qualifications</td>
<td>13.9 (107)</td>
<td>12.7 (61)</td>
<td>16.0 (46)</td>
<td>0.75 (0.42-1.35)</td>
</tr>
<tr>
<td><strong>Baseline occupation (n=739)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial and professional</td>
<td>46.7 (345)</td>
<td>49.8 (232)</td>
<td>41.4 (113)</td>
<td>REF</td>
</tr>
<tr>
<td>Intermediate</td>
<td>21.2 (157)</td>
<td>21.2 (99)</td>
<td>21.3 (58)</td>
<td>1.02 (0.66-1.58)</td>
</tr>
<tr>
<td>Routine and manual</td>
<td>31.8 (235)</td>
<td>28.8 (134)</td>
<td>37.0 (101)</td>
<td>0.82 (0.55-1.24)</td>
</tr>
<tr>
<td>Other</td>
<td>0.3 (2)</td>
<td>0.2 (1)</td>
<td>0.4 (1)</td>
<td>0.57 (0.34-0.93)</td>
</tr>
<tr>
<td><strong>Baseline long-standing illness (n=756)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>75.7 (572)</td>
<td>76.7 (26.18)</td>
<td>73.8 (203)</td>
<td>REF</td>
</tr>
<tr>
<td>Yes</td>
<td>24.3 (184)</td>
<td>23.3 (112)</td>
<td>26.2 (72)</td>
<td>1.03 (0.65-1.65)</td>
</tr>
<tr>
<td><strong>Follow-up long-standing illness (n=774)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>75.6 (585)</td>
<td>77.9 (277)</td>
<td>71.7 (208)</td>
<td>REF</td>
</tr>
<tr>
<td>Yes</td>
<td>24.4 (189)</td>
<td>22.1 (107)</td>
<td>28.3 (82)</td>
<td>0.80 (0.50-1.29)</td>
</tr>
<tr>
<td><strong>Baseline retirement (n=761)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not retired</td>
<td>87.5 (666)</td>
<td>87.3 (418)</td>
<td>87.9 (248)</td>
<td>REF</td>
</tr>
<tr>
<td>Retired</td>
<td>12.5 (95)</td>
<td>12.7 (61)</td>
<td>12.1 (34)</td>
<td>0.65 (0.37-1.15)</td>
</tr>
<tr>
<td><strong>Follow-up retirement (n=774)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not retired</td>
<td>75.7 (586)</td>
<td>71.9 (348)</td>
<td>82.1 (238)</td>
<td>REF</td>
</tr>
<tr>
<td>Retired</td>
<td>24.3 (188)</td>
<td>28.1 (138)</td>
<td>17.9 (52)</td>
<td>1.99 (1.25-3.15)</td>
</tr>
</tbody>
</table>
4.3.1 Smoking (n=736)

The proportion of current smokers decreased over time (OR 0.74, 95% CI 0.62-0.89, p=0.001), falling from 14.9% to 12.7% (Figure 4.1). Fewer FOBT participants were categorised as smokers compared with FOBT non-participants (OR 0.45, 95% CI 0.29-0.68, p<0.001). No group by time interaction was observed for smoking behaviour (OR 1.15, 95% CI 0.90-1.47, p=0.265), indicating men who participated in FOBT did not change their behaviour any more or less than non-participants.

Figure 4.1 The proportion of smokers over time, comparing FOBT participants and FOBT non-participants (n=736; FOBT participants n=465, FOBT non-participants n=271). Proportions adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status, and baseline wave.
4.3.2 Alcohol consumption (n=714)

The proportion of men meeting current alcohol consumption guidelines decreased over time (Figure 4.2), falling from 65.9% to 61.6% (OR 0.69, 95% CI 0.53-0.91, p=0.007). There was no difference in adherence to alcohol guidelines between the screened and non-screened groups (OR 0.87, 95% CI 0.62-1.23, p=0.434). No group by time interaction was observed for alcohol consumption (OR 1.34, 95% CI 0.96-1.85, p=0.082); compared with FOBT non-participants, FOBT participants were no more or less likely to change their alcohol consumption over time.

Figure 4.2 The proportion of men meeting guidelines for alcohol consumption over time, comparing FOBT participants and FOBT non-participants (n=714; FOBT participants n=457, FOBT non-participants n=257). Proportions adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status, and baseline wave. Missing data due to participant non-response.
4.3.3 Fruit and vegetable consumption (n=524)

The proportion of participants meeting guidelines for fruit and vegetable consumption did not change over time (45.0% vs 52.7%; OR 1.32, 95% CI 0.91-1.90, p=0.140). (Figure 4.3). Participants who took part in FOBT had greater odds of meeting fruit and vegetable consumption guidelines across both time points, compared with non-participants (OR 1.70, 95% CI 1.14-2.55, p=0.009). There was no interaction between group and time for fruit and vegetable consumption (OR 1.02, 95% CI 0.66-1.58, p=0.930). FOBT participants and non-participants were equally likely to change their behaviour.

Figure 4.3 Proportion of men meeting guidelines for fruit and vegetable consumption over time, comparing FOBT participants and FOBT non-participants (n=524; FOBT participants n=347, FOBT non-participants n=177). Proportions adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status, and baseline wave. This analysis includes a smaller sample size due to different, non-comparable items assessing fruit and vegetable consumption prior to wave 5.
4.3.4 Physical activity

The proportion of men taking part in MPA once or more per week did not change between baseline (88.6%) and follow-up (85.5%) measurements (n= 736; OR 0.75, 95% CI 0.49-1.15, p=0.187) (Figure 4). No differences in MPA were observed between FOBT participants and FOBT non-participants (OR 1.08, 95% CI 0.69-1.71, p=0.731). There was no group by time interaction (OR 0.97, 95% CI 0.57-1.67, p=0.927).

The proportion of men taking part in VPA once or more per week did not change between baseline (40.1%) and follow-up (41.2%) measurements (n=734; OR 0.83, 95% CI 0.64-1.01, p=0.178). There was no main effect of group on the proportion of men participating in VPA once or more per week (OR 0.79, 95% CI 0.57-1.08, p=0.142). A group by time interaction was found (OR 1.40, 95% CI 1.01-1.95, p=0.043; Figure 4.4). Among men who participated in FOBT, 38.7% participated in VPA once or more per week at baseline and 43.2% at follow-up. Among FOBT non-participants, 41.6% participated in VPA once or more per week at baseline and 37.5% at follow-up.

Figure 4.4 Proportion of men taking part in MPA (n=736; FOBT participants n=465, FOBT non-participants n=271) and VPA (n=734; FOBT participants n=464, FOBT non-participants n=270) once or more per week, over time, comparing FOBT participants and FOBT non-participants (proportions adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status, and baseline wave)
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4.4 Discussion

In this prospective cohort of screening-naïve men, there was a modest increase in the proportion of FOBT participants taking part in VPA once or more per week following their first invitation to participate in an NHS cancer screening programme. VPA decreased among the comparator group of screening non-participants, providing tentative support for FOBT as a teachable moment for VPA. However, there was no evidence for FOBT as a prompt for spontaneous changes to smoking, alcohol consumption, fruit and vegetable intake, or MPA.

These results are in line with the systematic review presented in Chapter 3, which included a published version of this chapter, and concluded there was little evidence for cancer screening as a prompt for spontaneous health behaviour change. However, the finding that VPA may increase after participating in colorectal cancer screening is similar to the previous single-arm observational study, which observed changes to PA following participation in the UK FS trial (Miles et al., 2003). The same study observed positive changes to smoking behaviour and fruit and vegetable consumption, which were not observed within the present study. Within the ELSA sample, smoking decreased among FOBT participants and non-participants. This suggests that although smoking appears to reduce over time, FOBT participation is unlikely to be the catalyst for change. This study adds more robust evidence, as it used a comparator group of screening non-participants, within a non-trial setting.

Previous research has found that MPA and VPA reduce with age within the ELSA cohort (Smith, Gardner, Fisher, & Hamer, 2015). Furthermore, interventions to increase PA among adults are generally only modestly effective (Conn, Hafdahl, & Mehr, 2011). It is, therefore, interesting that in this sample of ELSA participants, screening attendees appeared to increase their VPA without intervention. MPA remained stable over time and did not decrease in compensation for increased rates of VPA (Gomersall, Rowlands, English, Maher, & Olds, 2013). However, almost 90% of the sample reported engaging in MPA once or more per week at baseline, suggesting a ceiling effect. The effect of FOBT participation on VPA needs to be replicated in additional cohorts. However, it is possible that FOBT screening may provide a teachable moment, prompting spontaneous change for this behaviour.
Despite an absence of evidence to support positive changes to multiple health behaviours following FOBT screening, the present research does not support the suggestion of a ‘health certificate effect’. Previous research conducted within the context of FS screening suggested positive health behaviour change could be inhibited among screening participants (Larsen et al., 2007), although this effect was found only in the short term (Berstad et al., 2015). The findings of Study 2 are in line with a recent systematic review which did not find support for the idea that negative screening results cause over-reassurance (Cooper et al., 2017).

### 4.4.1 Strengths

This study was the first to explore health behaviour change following participation in an existing NHS bowel screening programme. This research used a novel methodology to select a sample of screening naïve FOBT participants and FOBT non-participants from a prospective cohort study. Building on single-arm observational research, this approach allowed for comparisons of health behaviour between groups. Furthermore, the sample included in this study is likely to be more representative compared with previous research. To confirm the representativeness of the analytic sample, comparisons were made with 2011 Census data (limited to English men, 60-64 years) for two key demographic variables: ethnicity and education. The proportion of white participants (Census = 94.4%, ELSA = 95.1%) and participants with education to degree level or above (Census = 25.2%, ELSA = 27.7%) were similar. Finally, analyses controlled for an important confounder: retirement. Retirement has been suggested as a teachable moment itself and found to be related to both levels of physical activity and FOBT uptake (Kelly, Olanrewaju, Cowan, Brayne, & Lafontune, 2018; Weber et al., 2013).

### 4.4.2 Limitations

This study has a number of limitations. Firstly the measures used within this study impact the interpretation of results and conclusions that can be drawn. The analysis of secondary data meant that measures included in the ELSA might not have been the most appropriate measures to assess behaviour change following FOBT participation. An example of this is that it was not possible to assess the mechanisms of change, as the ELSA did not include variables linked to the McBride et al. (2003) Teachable Moment Heuristic. Cancer screening did not appear to
prompt changes to most behaviours. However, it is likely that some participants made positive and negative changes following screening participation, which are masked by observing overall change between groups. Studies which distinguish between these participants and attempt to identify predictors of positive change may further our understanding of the teachable moment at screening.

The measures included in the ELSA may not be sensitive to change. For example, participants were asked to report the frequency of participation in sports or activities that are vigorous. The response options (more than once a week / once a week / one to three times a month / hardly ever or never) mean that participants may be able to improve their levels of physical activity without changing category. Therefore, more nuanced changes in behaviour may be missed. Without the use of sensitive measures, it is difficult to assess the clinical relevance of findings. All measures of health behaviour within the ELSA are self-reported. The use of objective measures, particularly for PA, may improve our understanding of FOBT as a teachable moment for behaviour change. Furthermore, several behavioural bowel cancer risk factors were not included in ELSA assessments, such as the consumption of red and processed meat, and fibre. Therefore, conclusions about the impact of FOBT participation on diet are limited to the consumption of fruits and vegetables. BMI is included in alternate ELSA assessments. However, the four-year gap between assessments of this outcome means that it was not possible to include this outcome in analyses.

Related to the measures used within the ELSA, is the timing of assessments. Firstly, it was not possible to determine the length of time between the FOBT invitation and follow-up assessment for participants. This means that someone’s follow-up measurement could have been just after their 60th birthday or at the end of their 61st year. In addition, the gap of up to two-years following FOBT invitation may mask any short-term changes in health behaviours following participation. The period immediately after screening may be most important for behaviour change (Anderson et al., 2009). Therefore, the biennial measures of health behaviour may limit our understanding of the teachable moment within a screening context. The results of study 2 do not suggest behaviour change that is sustained over the longer term. However, if short term behaviour change
occurs immediately after the screening appointment, interventions could capitalise on this to promote long term change.

While study four included a range of potential confounders, such as retirement, it is important to consider unmeasured confounders related to behaviour change and cancer screening. For example, one systematic review highlighted a range of sociodemographic (e.g. female gender, younger age) and psychological variables (e.g. self-perceived health status, higher bodyweight) associated with colorectal screening non-attendance (Wools, Dapper, & Leeuw, 2015). Including a wider range of potential confounders, such as those associated with screening attendance, may improve our understanding of behaviour change at cancer screening.

It has been suggested that positive behaviour change following screening may be observed predominantly among people who receive abnormal screening outcomes (Slatore et al., 2014). This study did not control for the impact of screening results on behaviour change. Although screening results were unknown for participants included in these analyses, the exclusion of participants with a diagnosis of cancer means it is likely the majority received a normal screening result. Only 2.5% of men will receive an abnormal result. Therefore, studies with larger sample sizes are needed to determine whether FOBT result impacts behaviour change (Logan et al., 2012).

The final limitations of this study relate to the generalisability of results. Within the sample, self-reported uptake of FOBT was 63%, compared with 54% uptake in the general population (von Wagner et al., 2011). Estimates of the accuracy of self-reported FOBT uptake vary, with some research suggesting it can be highly accurate, and others noting a 13% overestimation (Jones, Mongin, Lazovich, Church, & Yeazel, 2008; Lo, Waller, Vrinten, Wardle, & von Wagner, 2016). Despite the ELSA being broadly representative of demographic factors, it is possible that certain health behaviours, such as screening participation, are over-represented. This may be due to ELSA participants being more health-conscious than the general population. If ELSA participants are more health-conscious than the general population, this may limit the generalisability of results. Finally, this study included first-time male FOBT invitees. This means that findings are
Chapter 4. Lifestyle change associated with FOBT participation

not necessarily generalisable to other groups such as women, non-naïve attendees, and participants of other cancer screening programmes.

4.4.3 Directions for future research

As outlined in the introduction to this thesis, one prominent conceptualisation of the teachable moment is that of a prompt for spontaneous behaviour change following a cueing event (McBride et al., 2003). However, this study did not provide convincing evidence that spontaneous behaviour change occurs within the context of FOBT screening. Other conceptualisations of the teachable moment suggest that health events and settings are opportunities to deliver behaviour change interventions and advice (Lawson & Flocke, 2009). Within the ELSA sample, FOBT participants were less likely to smoke and more likely to meet guidelines for fruit and vegetable consumption compared with non-participants, which may reflect greater health awareness among this group. However, although the FOBT group displayed healthier behaviours than the non-screened group, health behaviours were sub-optimal. The proportion of men consuming alcohol in excess of current guidelines increased from baseline to follow-up, suggesting there may be a need for interventions targeting this behaviour among men in this age group. Furthermore, half of FOBT participants did not meet guidelines for fruit and vegetable consumption at follow-up, and more than half were not participating in VPA once or more per week. In line with recent public health initiatives, such as Making Every Contact Count (Public Health England, 2016b), cancer screening could provide an opportunity to deliver behaviour change interventions (Senore, Giordano, Bellisario, Di Stefano, & Segnan, 2012).

At present, bowel screening participants are not offered behavioural support. However, the information leaflet posted alongside bowel FOBT invitations lists physical activity, overweight and diet as risk factors for bowel cancer. It is not known whether the provision of this information impacts the health behaviours of invitees, nor how acceptable it is. However, it is likely that more intensive intervention is needed to support behaviour change. Previous, more intensive, behaviour change interventions in the screening context have predominantly targeted patients with screen-detected polyps. Trials of these interventions, aimed at promoting diet, PA, and weight loss, have documented encouraging changes to behaviour (Anderson et al., 2015; Baker
& Wardle, 2002; Caswell et al., 2009). However, most bowel screening participants will receive a normal result, highlighting the need for trials designed for participants with normal screening results. To date, no interventions have targeted FOBT participants. Further research is needed to assess the feasibility, acceptability and efficacy of interventions delivered alongside NHS bowel screening programmes.

4.5 Conclusion

In conclusion, FOBT participation did not appear to prompt long-standing, spontaneous, positive changes to multiple health behaviours within this sample of male ELSA participants, although modest spontaneous behaviour change was observed for VPA. Encouragingly, FOBT participation did not appear to discourage behaviour change. In the absence of convincing evidence for FOBT participation as a teachable moment for spontaneous behaviour change, future research should investigate the appetite for lifestyle advice in NHS cancer screening settings.
Chapter 5. Cancer screening as an opportunity to provide healthy lifestyle advice: public acceptability and preferences for lifestyle advice at NHS breast, bowel and cervical screening (Studies 3A and 3B)\textsuperscript{13}

5.1 Introduction to studies 3A and 3B

Studies 1 and 2 do not provide support for the hypothesis that cancer screening can prompt substantial, long-term positive or negative spontaneous changes to health behaviours. However, study 2 highlights a large proportion of screening participants who may benefit from lifestyle advice and interventions targeting cancer risk factors. Studies 3A and 3B will attempt to address the second aim of this thesis; to gauge interest in lifestyle advice at cancer screening.

There is little evidence that lifestyle advice is routinely delivered alongside cancer screening (Anderson et al., 2013). The delivery of lifestyle advice at cancer screening is in line with models that acknowledge the role of both health care professionals and health service users in initiating a teachable moment (Lawson & Flocke, 2009). Furthermore, viewing cancer screening as an opportunity to provide advice about maintaining a healthy lifestyle fits within policy to make every contact count (Public Health England, 2016b).

However, concerns have been raised about the potential for interventions delivered alongside cancer screening services to have an adverse effect on screening uptake. In one qualitative study, healthcare professionals were concerned that providing alcohol consumption advice in breast

\textsuperscript{13} A version of Study 3a has been published in the British Journal of Cancer. (0). Stevens, C., Vrinten, C., Smith, S.G., Waller, J., & Beeken, R.J. (2019). Acceptability of receiving lifestyle advice at cervical, breast and bowel cancer screening. Preventive Medicine, 120, 19-25. doi:http://dx.doi.org/10.1016/j.ypmed.2018.12.005

screening clinics could deter women from attending (Sinclair et al., 2019). Uptake of bowel screening is suboptimal, particularly for FS, and breast and cervical screening uptake are decreasing (McGregor et al., 2016; NHS Digital, 2018a, 2019a). It is, therefore, essential to ensure that any changes to cancer screening programmes do not negatively affect uptake.

The potential impact of lifestyle advice on screening uptake has been explored in breast and cervical screening settings. Less than 1% of 413 breast screening attenders indicated they would be less willing to attend breast screening if lifestyle advice was provided (Fisher et al., 2007). However, this study only sampled previous screening attenders from two breast screening clinics in North and East Yorkshire. Furthermore, the survey response rate was only 61%. Results from an RCT suggest the provision of smoking cessation advice alongside NHS cervical screening would not affect future screening uptake (Hall et al., 2007). The study explored the feasibility, acceptability and effectiveness of smoking cessation advice among a group receiving advice (n=121) compared with a control group (n=121). Intention to participate in future screening appointments across the intervention and control group were similar at two- and ten-week follow-up. However, loss to follow up was high (35% at 10 weeks in the intervention group), and the trial participants may have been more health-conscious than the general screening population. Despite two encouraging studies conducted within NHS screening programmes, it is essential to determine whether these results are replicable in representative samples across all NHS screening programmes and to understand factors that may influence interest.

Several studies have examined preferences for lifestyle advice in the context of cancer screening. The study by Fisher et al. (2007) explored the topics of advice that women would be interested in. Most participants (85.4%) were open to receiving advice about diet and exercise. Within the context of bowel screening, 95% of 537 colonoscopy participants indicated they would be willing to receive advice from a healthcare professional (Srpanlop et al., 2018). Other mediums of advice were explored in the same study including print materials (90.3% interest) and an internet-based health education programme (51.1% interest). The high proportion of participants wanting to receive this advice directly from a healthcare professional suggests a preference for the delivery of advice at the screening appointment itself. The sample included low-income African
American and Hispanic populations in the USA, so it is not known whether these findings are generalisable to English populations. Furthermore, previous research has focused on limited topics of advice (e.g. diet and physical activity). Therefore, it is not known whether advice about a range of cancer preventive behaviours would be acceptable at screening.

When assessing the acceptability and impact of lifestyle advice in cancer screening settings, it is important to consider potential determinants of interest in advice. There are a number of sociodemographic factors associated with screening uptake, including socioeconomic position, ethnicity, and gender (Douglas, Waller, Duffy, & Wardle, 2016; McGregor et al., 2016; Moser, Patnick, & Beral, 2009; von Wagner et al., 2011). These could be important factors to consider when designing interventions. If lower socioeconomic position groups are less likely to participate in screening, and advice is less acceptable to lower socioeconomic groups, screening inequalities could be widened. One lifestyle intervention conducted within a population of participants with screen-detected adenoma reported high levels of recruitment and retention from deprived groups and found no differences in behavioural outcomes between more and less deprived groups (Fisher, Craigie, Macleod, Steele, & Anderson, 2017). However, the participants in this sample are not reflective of the general screening population, for whom the majority will receive a negative screening result. To date, no studies have reported on sociodemographic differences of the acceptability of interventions delivered in NHS cancer screening programmes.

As well as sociodemographic variations in acceptability of lifestyle advice at screening, there may be other factors related to openness to lifestyle advice. For example, one study found interest in diet and physical activity advice at breast screening was greater among women affected by overweight (93.4%), compared with participants who were not affected by overweight (80.3%) and women with obesity (Fisher et al., 2007). This research suggests further research is needed to understand the impact of current health behaviour on receptivity to lifestyle advice.

Risk perceptions have also been found to be important in motivating health behaviour change (Ferrer & Klein, 2015). In addition, proposed models of the teachable moment include elements of risk perceptions (Lawson & Flocke, 2009; McBride et al., 2003). For example, the McBride et al. (2003) heuristic proposes that teachable moments are created by events which change
people’s perceptions of risk, and another model describes the role of perceived threat of a disease (Lawson & Flocke, 2009). While risk perceptions have been suggested as important factors in creating a teachable moment, it is not yet known whether risk perceptions are associated with interest in lifestyle advice in screening settings. Furthermore, it has been suggested that it is important to ensure that people are aware of risk factors for cancer, and how these relate to their own behaviour (Anderson et al., 2013; Stead et al., 2012). One qualitative study set within cervical screening found that most participants were unaware of the link between smoking and cervical cancer (Mansour et al., 2019). Participants felt that if cessation advice were to be provided alongside cervical screening, an explanation of the link would be required. Therefore, understanding whether risk perceptions and risk factor awareness influence receptivity to lifestyle advice may further our understanding of cancer screening as a teachable moment.

The limited scope of previous research in this area leaves a number of critical issues to consider before implementing routine lifestyle advice within NHS cancer screening programmes. Firstly, it is not known whether the provision of lifestyle advice is acceptable across all NHS cancer screening programmes. Secondly, the impact of the provision of advice on screening uptake remains unclear, particularly for bowel cancer screening. It is also essential to understand patients’ preferences for the content and delivery of advice. Finally, it is important to investigate potential determinants of receptivity of advice at cancer screening to develop effective and equitable interventions. This chapter will attempt to answer a number of these key questions within a single population-representative survey of English adults.

In line with the second aim of this thesis, the work presented in this chapter to aims gauge interest in lifestyle advice at cancer screening. Two studies, reporting data from the same population survey addressed the following objectives:

5.1.1 Study 3A

This study sought to determine levels of willingness to receive information about lifestyle within existing cancer screening programmes (breast, bowel and cervical screening programmes), including in the event of screening results which require further investigations. This study also aimed to identify sociodemographic determinants of willingness to receive advice and the
potential impact of lifestyle advice on future screening participation. Finally, participants’ preferred timing of advice was explored within this study. Three screening modalities were explored: breast, FS and cervical.

5.1.2 Study 3b
Study 3b aimed to measure public interest in advice about five separate topics of lifestyle advice at cancer screening: diet, weight, physical activity, smoking, and alcohol consumption. In addition, this research aimed to identify sociodemographic, psychological (risk perception, cancer risk factor awareness) and behavioural correlates of interest in each of the lifestyle advice topics. The sample selected for this study were people who intended to participate in any NHS cancer screening programmes in the future; breast, bowel or cervical screening.

5.2 Study 3A. Acceptability of receiving lifestyle advice at cervical breast and bowel cancer screening

5.2.1 Methods

5.2.1.1 Design
Data were collected as part of the Attitudes, Behaviour, and Cancer-UK Survey (ABACUS). The ABACUS is a cross-sectional population-representative survey on the determinants of early detection and prevention behaviours related to cancer. Face-to-face computer-assisted personal interviews were conducted at participants’ homes as part of an omnibus survey run by market research agency Taylor Nelson Sofres (TNS) in April and May 2016. Ethical approval was granted by the University College London Research Ethics Committee (Ref: 5771/002). Verbal consent was obtained at the start of interviews.

5.2.1.2 Participants
A sample of 2048 English adults (aged 18-70) was recruited using a hybrid of stratified random location and quota sampling methods. Census data from 2011 and Postcode Address File data were used to determine sampling areas. Within areas, quotas were set for gender, working status and presence of children in the home to ensure a nationally representative sample. Weights were
provided by the market research agency, which once applied resulted in a sample that is nationally representative. Questions relating to study 3A were limited to three sub-samples. In line with current screening guidelines in England, women aged 25-64 (n=768) were asked questions about cervical screening and women aged 47-70\(^{15}\) were asked questions about breast screening (n=420). Questions about bowel scope screening were asked of men and women aged 45-54 (n=308). In England, people are invited to a one-off bowel scope screening appointment at the age of 55. So that intention to attend screening and the impact of advice on future screening attendance could be measured, questions relating to bowel scope screening were only asked of people approaching screening age. Participants with a previous diagnosis of cancer (excluding non-melanoma skin cancer) were excluded from the study.

5.2.1.3 General measures

A full copy of the measures is included in Appendix F.

**Sociodemographic variables:** Data were collected for age, gender, ethnicity and educational attainment (as a marker of social position). Ethnicity was categorised into White (participants who identified as White British, Irish, Gypsy or Irish Traveller, and Other White groups) and non-White (Mixed or multiple ethnic groups; Asian or Asian British; Black African, Caribbean, Black British; Other ethnic group) based on UK Census ethnicity classifications\(^ {16}\) due to the small proportion of non-White participants within the sample. Education was measured using the item ‘what is the highest level of educational qualification you have obtained’, with responses categorised into ‘degree level or above’ (Bachelor’s degree / Further degree or higher, e.g. Master’s, PhD) and ‘education below degree level’ (No formal qualifications, O-Level or GCSE equivalent, ONC\(\)/BTEC, A-Levels or Highers, Higher education below degree, Other, Still studying). Participants were able to select ‘refuse’ or ‘don’t know’ for the measure of education; these responses were coded as missing. Education is a common marker of socioeconomic position\(^ {15}\).

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15 The age range for breast screening participants reflects the trialled extension to the age range for the NHS breast screening programme (47-73) and the age cap for the survey (70).
16 [https://www.ethnicity-facts-figures.service.gov.uk/ethnic-groups](https://www.ethnicity-facts-figures.service.gov.uk/ethnic-groups)
(SEP), as it is easy to administer and interpret, and generally results in high response rates from participants (Galobardes, Shaw, Lawlor, Lynch, & Davey Smith, 2006).

**Cancer screening intention:** Intention to participate in cancer screening was asked separately for three screening modalities; breast, FOBT, cervical. For cervical screening, women were asked ‘Will you go for cervical screening when / next time you are invited?’ For breast screening, women were asked ‘Will you go for breast screening when, or next time you are invited?’ For FOBT screening, people were asked ‘Will you do the stool test when / the next time you are invited?’ Four response options were offered (Yes, definitely; Yes, probably; No, probably not; No, definitely not), dichotomised into yes and no. Participants were able to select ‘refuse’ or ‘don’t know’ for measures of screening intention; these responses were coded as missing.

**Previous cancer diagnosis:** Participants were asked if they had received a previous diagnosis of cancer ‘Have you ever been diagnosed with cancer? (Please answer ‘no’ if you have been diagnosed with non-melanoma skin cancer)’ (yes / no). This question was used to select a sample of participants without a diagnosis of cancer. Participants with a previous diagnosis of cancer were excluded, as a cancer diagnosis is considered by some as a teachable moment itself (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005).

**Willingness to receive lifestyle advice at cancer screening:** For those intending to attend cervical, breast or bowel cancer screening, willingness to receive lifestyle advice was measured using three versions of the item ‘Would you be willing to receive advice about making healthy lifestyle changes (for example, diet or physical activity) as part of the cervical/breast/bowel screening programme?’. Five response options were offered, which were used to categorise people as willing (Yes, definitely; Yes, probably), or not willing (No, probably not; No, definitely not; Not sure). Responses were dichotomised as few participants selected the three latter response options. For each screening programme, an additional question assessed interest in lifestyle advice in the event of a screening result which required further investigations; ‘Would you be willing to receive lifestyle advice if your screening result suggested you needed to have further investigations?’ The same response options were used for this item. Participants were able to
refuse to answer questions relating to willingness to receive lifestyle advice at cancer screening, refusals were coded as missing.

**Impact of lifestyle advice on cancer screening participation:** Participants eligible to attend any of the three screening programmes were asked; ‘If you knew you would receive advice about lifestyle as part of the cervical/breast/bowel screening programme, would this affect your willingness to attend cervical/breast/bowel screening?’ Three response options were provided (Yes, I would be more willing to attend; Yes, I would be less willing to attend; No, it would not affect my willingness to attend). Participants were able to refuse to answer questions relating to the impact of lifestyle advice on cancer screening participation, refusals were coded as missing.

**Timing of lifestyle advice:** Preferences for the timing of lifestyle advice were assessed among participants who were intending to attend screening and willing to receive lifestyle advice ‘When would you prefer to receive lifestyle advice as part of the cervical/breast/bowel screening programme?’ Five response options were provided: at the same time as my screening appointment; with my screening results; 2-4 weeks after attending screening; 1-3 months after attending screening; more than 3 months after attending screening. Participants were able to refuse to answer questions relating to the timing of lifestyle advice, refusals were coded as missing.

Participants were shown questions relating to all of the screening programmes they were eligible for, meaning women were asked about up to three screening programmes, whereas men were asked about just one.

**5.2.1.4 Survey development**

To assess the comprehension of items, particularly of those which were not validated, cognitive interviews were conducted (n=14). Participants were presented with the whole survey and asked to answer all questions to the best of their ability. Notes were made when participants had difficulty with a particular item. Participants were asked to provide feedback on individual items (e.g. comprehension and clarity) and the survey as a whole (e.g. length). Amendments were made to non-validated items before the survey was piloted online (n=392). A population representative
Chapter 5. Interest in lifestyle advice within NHS cancer screening programmes

Sample was recruited by Survey Sampling UK Ltd. Quotas were set for age, gender and level of education. Participants were aged 18-70 years. Participants were sent a link to an online survey hosted by UCL. Items which had not been validated, or previously used were included in the online pilot. The distribution of responses was assessed, including the proportion of people who did not answer each item. For example, for the question relating to interest in lifestyle advice at cervical screening, no participants refused to answer the question and few participants selected ‘not sure’ (2.8%). Therefore, the item was approved for inclusion in the main survey. Combined, the cognitive interviews and online pilot informed final changes to the survey before data collection.

5.2.1.5 Analyses
Descriptive analyses explored willingness to receive information around the time of screening, the effect of information provision on screening uptake and timing preferences. Three McNemar’s tests explored differences between interest in lifestyle advice around screening in general and interest in the event that further investigations were required. Three logistic regression models were conducted, simultaneously entering age, gender, ethnicity, and education to identify sociodemographic correlates of willingness to receive lifestyle advice at cervical, breast and FS screening. Weights were used to ensure population representativeness. These were calculated by market research company TNS and based on age, region, social grade and working status. Sample characteristics are presented weighted in text; both weighted and unweighted sample characteristics are presented in table 5.1. Univariate and bivariate analyses are presented weighted. Multivariate analyses are presented unweighted. Logistic regression analyses were conducted on complete cases. Descriptive statistics are presented for all available cases.

5.2.2 Results

5.2.2.1 Sample characteristics
A total of 1037 (weighted N =1041) participants were included in the analyses (Table 5.1). The mean age of the analytic sample was 47.6 years (SD 12.1). Most were female (81.1%, n=844), reflecting the screening modalities studied. The majority were white (86.7%, n=898) and educated at below degree level (56.0%, n=653). The cervical screening sample included 768 women aged
25-70 (weighted n=739), the breast screening sample included 420 women aged 47-70 (weighted n=430), and the FS screening sample included 308 men and women aged 45-54 (weighted n=386). Characteristics for each of the three groups are presented in Table 5.1.
### Table 5.1 Demographic characteristics of the total analytic sample and sub-samples for the cervical, breast, and FS screening scenarios

<table>
<thead>
<tr>
<th></th>
<th>Total analytic sample</th>
<th>Cervical screening sample</th>
<th>Breast screening sample</th>
<th>FS screening sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unweighted (n=1037)</td>
<td>Weighted (n=1041)</td>
<td>Unweighted (n=768)</td>
<td>Weighted (n=739)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Unweighted (n=420)</td>
<td>Weighted (n=430)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Unweighted (n=308)</td>
<td>Weighted (n=386)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>M (46.7)</td>
<td>M (47.6)</td>
<td>M (43.9)</td>
<td>M (49.7)</td>
</tr>
<tr>
<td></td>
<td>SD (13.0)</td>
<td>SD (12.1)</td>
<td>SD (11.5)</td>
<td>SD (11.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>147 (14.2)</td>
<td>197 (18.9)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>890 (85.8)</td>
<td>844 (81.1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>886 (85.9)</td>
<td>898 (86.7)</td>
<td>647 (84.8)</td>
<td>378 (90.7)</td>
</tr>
<tr>
<td>Non White</td>
<td>146 (14.2)</td>
<td>138 (13.3)</td>
<td>116 (15.2)</td>
<td>39 (9.4)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree level or above</td>
<td>294 (29.9)</td>
<td>337 (34.0)</td>
<td>245 (33.6)</td>
<td>85 (21.7)</td>
</tr>
<tr>
<td>Qualifications below bachelor's degree level</td>
<td>688 (70.1)</td>
<td>653 (65.0)</td>
<td>484 (66.4)</td>
<td>307 (78.3)</td>
</tr>
<tr>
<td><strong>Intention to attend screening</strong></td>
<td>-</td>
<td>-</td>
<td>671 (94.9)</td>
<td>362 (92.8)</td>
</tr>
<tr>
<td>Intends</td>
<td>-</td>
<td>-</td>
<td>671 (94.9)</td>
<td>362 (92.8)</td>
</tr>
<tr>
<td>Does not intend</td>
<td>-</td>
<td>-</td>
<td>36 (5.1)</td>
<td>28 (7.2)</td>
</tr>
</tbody>
</table>

1 No missing data
2 Based on dichotomisation of UK Census classifications
3 Five participants with missing data from total analytic sample (0.5%)
4 55 participants with missing data from total analytic sample (5.3%)
5 61 participants missing for cervical screening sample (7.9%), 30 participants missing for breast screening sample (7.1%), 23 participants missing for FS screening sample (7.5%).
5.2.2.2 Willingness to receive lifestyle advice at cancer screening

Intention to participate in the three cancer screening programmes was high (cervical 95.4%, n=651; breast 94.0%, n=378; FS 87.1%, n=311; weighted estimates). Of those intending to attend cervical screening, most were willing to receive lifestyle advice alongside the NHS cervical screening programme (78.9%, n=512). However, a greater proportion of this group were willing to receive advice if they received an abnormal screening result (86.3%, n=558; McNemar’s $\chi^2$ 22.0, df=644, p<0.001). Most women who intended to attend breast screening were willing to receive lifestyle advice alongside breast screening (79.4%, n=300; Table 5.2). A similar proportion of this group indicated they would be willing to receive advice if they received an abnormal screening result (83.0%, n=262; McNemar’s $\chi^2$ 23.38, df=374, p=0.087). For those intending to attend FS, the majority (81.8%, n=252) were willing to receive lifestyle advice alongside bowel cancer screening. A similar proportion of this group were willing to receive advice if they received an abnormal screening result (85.1%, n=252; McNemar’s $\chi^2$ 2.63, df=307, p=0.143).

5.2.2.3 Sociodemographic correlates of willingness to receive lifestyle advice

Ethnicity and educational attainment were associated with willingness to receive advice at cervical screening (Table 5.3). Compared with white participants, non-white participants had greater odds of being willing to receive lifestyle advice (89.8% vs 77.0%; OR 2.39, 95% CI 1.16-4.93, p=0.018). Participants who reported education below degree level had lower odds of being willing to receive lifestyle advice at cervical screening when compared with participants who reported education at degree level or above (75.9% vs 87.0%; OR 0.52, 95%; CI 0.33-0.82, p=0.005). There were no associations between sociodemographic characteristics and willingness to receive lifestyle advice at breast screening. For FS screening, women had greater odds of reporting willingness compared with men (87.7% vs 74.8%; OR 2.35, 95% CI 1.17-4.75, p=0.017).

In a sensitivity analysis\(^7\), we explored whether previous screening experience was associated with interest in lifestyle advice at breast and cervical screening. Most women in our samples had

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\(^7\) Items asked “Which one of the following best describes you?” separately in relation to breast and cervical screening. The following response options were provided: I have never heard of
previous experience of breast (85.6%) and cervical screening (73.1%). Adding past screening attendance to the models did not change the direction or statistical significance of any correlates in either model, and past screening attendance was not associated with interest in advice at breast (OR 1.37, 95% CI 0.57-3.30, p=0.479) or cervical screening (OR 1.19, 95% CI 0.65-2.16, p=0.573).

cervical/breast screening (1) I have heard of cervical / breast screening but have never been invited (2) I have been invited to cervical / breast screening but have never been (3) I have been invited to cervical / breast screening but have not been every time I was invited (4) I have been invited to cervical / breast screening and have been every time I was invited (5). The final two response options were used to categorise participants as having prior experience of the screening programme.
Table 5.2 Willingness to receive lifestyle advice in cervical, breast, and FS screening scenarios

<table>
<thead>
<tr>
<th>Willing to receive lifestyle advice at cancer screening</th>
<th>Willing to receive lifestyle advice if further investigations are needed</th>
<th>McNemars χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>% (95% CI)</td>
<td>Dichotomised % (95% CI)</td>
<td>n</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Cervical cancer screening (n=649)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, definitely</td>
<td>368</td>
<td>56.8 (52.8-60.7)</td>
<td>Yes, definitely</td>
</tr>
<tr>
<td>Yes, probably</td>
<td>144</td>
<td>22.1 (19.1-25.6)</td>
<td>Yes, probably</td>
</tr>
<tr>
<td>No, probably not</td>
<td>50</td>
<td>7.8 (5.9-10.2)</td>
<td>No, probably not</td>
</tr>
<tr>
<td>No, definitely not</td>
<td>62</td>
<td>9.6 (7.4-12.2)</td>
<td>No, definitely not</td>
</tr>
<tr>
<td>Not sure</td>
<td>25</td>
<td>3.8 (2.6-5.5)</td>
<td>21.1 (18.0-24.6)</td>
</tr>
<tr>
<td><strong>Breast cancer screening (n=377)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, definitely</td>
<td>214</td>
<td>56.7 (51.2-61.9)</td>
<td>Yes, definitely</td>
</tr>
<tr>
<td>Yes, probably</td>
<td>86</td>
<td>22.7 (18.5-27.6)</td>
<td>Yes, probably</td>
</tr>
<tr>
<td>No, probably not</td>
<td>30</td>
<td>8.0 (5.5-11.4)</td>
<td>No, probably not</td>
</tr>
<tr>
<td>No, definitely not</td>
<td>36</td>
<td>9.6 (6.9-13.4)</td>
<td>No, definitely not</td>
</tr>
<tr>
<td>Not sure</td>
<td>11</td>
<td>3.0 (1.7-5.3)</td>
<td>20.6 (16.6-25.3)</td>
</tr>
<tr>
<td><strong>FS screening (n=307)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, definitely</td>
<td>159</td>
<td>51.5 (44.9-58.1)</td>
<td>Yes, definitely</td>
</tr>
<tr>
<td>Yes, probably</td>
<td>93</td>
<td>30.3 (24.5-36.8)</td>
<td>Yes, probably</td>
</tr>
<tr>
<td>No, probably not</td>
<td>23</td>
<td>7.5 (4.8-11.7)</td>
<td>No, probably not</td>
</tr>
<tr>
<td>No, definitely not</td>
<td>26</td>
<td>8.6 (5.5-13.3)</td>
<td>No, definitely not</td>
</tr>
<tr>
<td>Not sure</td>
<td>6</td>
<td>2.1 (0.9-4.7)</td>
<td>18.2 (13.7-23.9)</td>
</tr>
</tbody>
</table>

¹ Data presented is weighted
Table 5.3 Sociodemographic correlates of willingness to receive lifestyle advice in cervical, breast and FS screening scenarios (mutually adjusted logistic regression models)

|                      | Cervical screening sample (n=637)
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td>Age</td>
<td>0.99</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>-</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>REF</td>
</tr>
<tr>
<td>Non-White</td>
<td>2.39</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Degree level or above</td>
<td>REF</td>
</tr>
<tr>
<td>Qualifications below bachelor’s degree level</td>
<td>0.52</td>
</tr>
</tbody>
</table>

1Data is presented unweighted
2Based on dichotomisation of UK Census classifications
5.2.2.4 Impact of information provision on screening uptake

Across the three cancer screening programmes, the majority of participants indicated the provision of lifestyle advice around the time of screening would not affect their willingness to attend (cervical 63.9%, n=414; breast 58.6%, n=218; FS 70.4%, n=217) (Figure 5.1). Some participants stated the provision of lifestyle advice would make them more willing to attend (cervical 31.2%, n=202; breast 34.4%, n=128; FS 20.8%, n=64). However, for each of the screening programmes, a small minority of people felt the provision of advice would make them less willing to participate in future cancer screening (cervical 4.9%, n=32; breast 7.0%, n=26; FS 8.8%, n=27).

Figure 5.1 Impact of the provision of lifestyle advice on willingness to attend cancer screening, among participants who intend to attend their next cancer screening appointment
5.2.2.5 Preferred timing of lifestyle advice at cancer screening

Most participants who were willing to receive lifestyle advice preferred this advice to be delivered at the screening appointment itself: cervical 69.8%, n=353; breast 72.6%, n=211; and FS screening 70.7%, n=176 (Figure 5.2). The next preferred timing for lifestyle advice was with the screening results (cervical 21.2%, n=107; breast 18.9%, n=55; FS 17.4%, n=43). Few participants wanted advice 2-4 weeks after attending screening (cervical 6.6%, n=33; breast 6.9%, n=20; FS 9.3%, n=23), 1-3 months after attending (cervical 1.6%, n=8; breast 1.1%, n=3; FS 1.5%, n=4), or more than three months after attending (cervical 0.9%, n=4; breast 0.5%, n=1; FS 1.1%, n=3).

Figure 5.2 Preferred timing of lifestyle advice at cervical, breast and FS screening
Chapter 5. Interest in lifestyle advice within NHS cancer screening programmes
5.3 Study 3b. Willingness to receive advice about diet, weight, physical activity, smoking and alcohol consumption in cancer screening settings

5.3.1 Design

Data for studies 3A and 3B were drawn from the same survey. For full details of the study design, please refer to section 5.2.1. It was not possible to include all items for each screening programme individually, due to limited space within the survey. Therefore, in study 3B questions were asked about cancer screening in general, rather than for individual screening programmes.

5.3.1.1 Participants

This study included a single sub-sample of men and women currently eligible to participate in breast, bowel (FS or FOBT) or cervical screening, and people approaching the age of eligibility. People approaching the age of eligibility for cancer screening were included for two reasons. Firstly, if lifestyle advice is routinely offered alongside cancer screening it is important to sample potential future attenders as well as people currently eligible to attend. Secondly, the narrow age range of patients invited to take part in flexible sigmoidoscopy and delays in the roll-out of this screening programme would have limited our sample of men. Participants were included in the analysis if they intended to take part in at least one of the cancer screening programmes. People classified as currently eligible for cancer screening were women aged 25-70, and men aged 60-70, and people classified as approaching eligibility were women aged 18-24 and men aged 45-59. After excluding participants with a diagnosis of cancer (n=121), people who did not meet age requirements (n=471), and people who did not intend to attend a cancer screening programme in the future (n=235), there was a final sample of 1221.

5.3.1.2 Measures

Sociodemographic variables were included as described in section 5.2.3. Measures of breast, FS bowel, FOBT bowel and cervical screening intention were used to select the sample. Participants who did not intend to attend any of these cancer screening programmes were excluded from
further analyses. A composite item was created which identified participants intending to take part in at least one of the screening programmes in the future.

**Knowledge of cancer risk factors**: Knowledge of cancer risk factors was assessed using an 11-item scale from the Cancer Research UK Cancer Awareness Measure (CRUK CAM; Stubbings et al., 2009). Participants were presented with 11 risk factors for cancer, including smoking, exposure to another person’s cigarette smoke, alcohol consumption, inadequate fruit and vegetable consumption, red and processed meat consumption, overweight, childhood sunburn, age over 70 years, having a close relative with cancer, infection with HPV, and physical inactivity (‘How much do you agree that each of these can increase a person’s chance of developing cancer?’). Five response options were provided, which were categorised into correct (agree / strongly agree) or incorrect (strongly disagree / disagree / not sure). For each participant, the number of risk factors that they correctly identified was combined giving each participant a score out of 11.

**Comparative cancer risk**: Comparative cancer risk perception was assessed using the item ‘How would you rate your chances of getting cancer, compared with other men / women your age?’ adapted from existing measures (Dillard, Ferrer, Ubel, & Fagerlin, 2012; Zajac, Klein, & McCaul, 2006). Five response options were categorised into lower (much lower / a little lower), the same (about the same), and higher (a little higher / much higher).

**Current health behaviours**: Fruit and vegetable consumption was assessed using two items (Cappuccio et al., 2003); ‘Over the past month, how many portions of fruit / vegetables did you usually eat?’ Responses options were: less than 1 per week, 1 per week, 2-3 per week, 4-6 per week, 1 per day, 2 per day, 3 or more per day. Values greater than or equal to 1 or more per day for each item were added together to create a composite measure of daily fruit and vegetable consumption. Participants consuming five or more portions of fruit and vegetables per day were classified as meeting guidelines. Body Mass Index (BMI; kg/m²) was calculated from self-reported height and weight. Participants were able to state their weight in kilograms, or in stone and pounds and pounds only (which were converted to kilograms). Participants were able to impute their height in meters, or as feet and inches (which were converted to meters). Implausible BMI data
were excluded (BMI < 14 / > 50; n=12). BMI was dichotomised to ≥25 (overweight) vs <25 (not overweight). A single item was used to assess levels of physical activity ‘In the past week on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?’ (Milton, Bull, & Bauman, 2011; Milton, Bull, & Clemes, 2013). Participants taking part in 30 minutes of physical activity on five or more days per week were classified as meeting guidelines (Department of Health, 2011b). Smoking status was assessed using a single item; ‘Do you smoke at all nowadays?’ Participants were categorised as smokers (Yes, I smoke daily; Yes, I smoke occasionally) or non-smokers (Not now, but I used to smoke daily; Not now, but I used to smoke occasionally; I’ve tried smoking in the past, but have never been a smoker; I have never smoked). Alcohol consumption items were adapted from the AUDIT-C questionnaire (Department of Health, 2013). ‘In a typical week, on how many days do you have a drink containing alcohol?’ and ‘How many units of alcohol do you drink on a typical day when you are drinking?’ Participants were given visual guidance on the number of units in standard measures of alcoholic drinks. Participants consuming 14 units or less per week were classified as meeting guidelines for alcohol consumption (UK Chief Medical Officer, 2016).

**Willingness to receive different types of lifestyle advice at cancer screening:** The following questions were asked of participants intending to take part in at least one screening programme in the future; ‘At cancer screening / If you were to attend cancer screening in the future, how interested would you be in any information or advice to… Help you have a healthy diet / Help you maintain a healthy weight / Help you increase your physical activity / Help you stop smoking / Help you reduce your alcohol consumption?’ Five response options were collapsed into ‘interested’ (a little interested / somewhat interested / very interested) and ‘not interested’ (not at all interested / not applicable).

5.3.1.3 Analyses

Five adjusted logistic regression models explored sociodemographic, psychological and behavioural correlates of interest in each of the categories of lifestyle advice among people intending to participate in cancer screening in the future. The simultaneous entry method was used and each model included variables which have been associated with health behaviours and
cancer screening participation: age, gender, ethnicity, educational attainment, screening eligibility (currently eligible vs eligible in the near future), cancer risk factor recognition, comparative cancer risk, and current health behaviours.

In addition to the main analysis, which included a composite cancer risk factor recognition score, a sensitivity analysis explored whether knowledge of individual risk factors (smoking, alcohol consumption, fruit and vegetable consumption, physical activity, overweight) were associated with interest in information about their corresponding topics of advice. Models were mutually adjusted for age, gender, ethnicity, educational attainment, comparative cancer risk, and current health behaviour.

Survey weights calculated by the market research company were applied to adjust for response bias (based on age, region, social grade, and working status). Sample characteristics and descriptive statistics are presented unweighted and weighted, multivariate analyses are presented unweighted. Participants with a previous diagnosis of cancer and those who did not intend to take part in screening were excluded from analyses. Data were analysed using Stata SE 14. An alpha level of p<0.010 was used to adjust for multiple testing (Streiner, 2015).

5.3.2 Results

5.3.2.1 Sample characteristics

Of the 2048 adults included in the ABACUS, 1221 were included in this analysis (Table 5.4). The mean age of the sample was 46.9 (SD 15.1). Three quarters (73.8%, n=901) were female, which reflects the inclusion criteria based on screening eligibility. The majority (87.9%, n=1070) were White. One-third of the sample (32.1%, n=375) were educated to degree level or above. Three-quarters of the sample (75.1%, n=917) were currently eligible to participate in at least one cancer screening programme, with the remainder approaching the age at which they become eligible.

The majority of the sample did not smoke (84.6%, n=1028), and consumed fewer than 14 alcoholic units per week (88.5%, n=1054). Half of the sample had a BMI of 25 or lower (48.8%, n=499). Around one-third reported meeting guidelines for fruit and vegetable consumption (37.2%, n=452) and physical activity (30.4%, n=369). Most of the sample reported their risk of
developing cancer to be the same as others of their age and sex (60.5%, n=711), 14.1% (n=166) rated their risk as higher and 25.4% (n=298) rated their risk as lower. On average, people were able to recognise 5.9 (SD 2.7) of the 11 cancer risk factors. For unweighted sample characteristics, see Table 5.4.

Table 5.4 Sample characteristics

<table>
<thead>
<tr>
<th></th>
<th>Weighted (n=1221)</th>
<th>Unweighted (n=1250)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>46.9</td>
<td>46.6</td>
</tr>
<tr>
<td></td>
<td>15.1</td>
<td>15.7</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>320</td>
<td>941</td>
</tr>
<tr>
<td></td>
<td>23.2</td>
<td>24.7</td>
</tr>
<tr>
<td>Female</td>
<td>901</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>73.8</td>
<td>75.3</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1070</td>
<td>1090</td>
</tr>
<tr>
<td></td>
<td>87.9</td>
<td>87.5</td>
</tr>
<tr>
<td>Non-White</td>
<td>148</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td>12.1</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree level or above</td>
<td>375</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td>32.1</td>
<td>27.8</td>
</tr>
<tr>
<td>Qualifications below degree level</td>
<td>792</td>
<td>861</td>
</tr>
<tr>
<td></td>
<td>67.9</td>
<td>72.2</td>
</tr>
<tr>
<td><strong>Eligibility for screening</strong></td>
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<td></td>
</tr>
<tr>
<td>Currently eligible</td>
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<td>978</td>
</tr>
<tr>
<td></td>
<td>75.1</td>
<td>78.2</td>
</tr>
<tr>
<td>Approaching eligibility</td>
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<td>272</td>
</tr>
<tr>
<td></td>
<td>24.9</td>
<td>21.8</td>
</tr>
<tr>
<td><strong>Adherence to health behaviour guidelines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit and vegetable consumption</td>
<td>452</td>
<td>436</td>
</tr>
<tr>
<td></td>
<td>37.2</td>
<td>35.1</td>
</tr>
<tr>
<td>BMI</td>
<td>499</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>48.8</td>
<td>48.3</td>
</tr>
<tr>
<td>Physical activity</td>
<td>369</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>30.4</td>
<td>30.2</td>
</tr>
<tr>
<td>Smoking</td>
<td>1028</td>
<td>1038</td>
</tr>
<tr>
<td></td>
<td>84.6</td>
<td>83.4</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>1054</td>
<td>1088</td>
</tr>
<tr>
<td></td>
<td>88.5</td>
<td>89.3</td>
</tr>
<tr>
<td><strong>Comparative cancer risk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td>166</td>
<td>176</td>
</tr>
<tr>
<td></td>
<td>14.1</td>
<td>14.7</td>
</tr>
<tr>
<td>Same</td>
<td>711</td>
<td>726</td>
</tr>
<tr>
<td></td>
<td>60.5</td>
<td>60.7</td>
</tr>
<tr>
<td>Lower</td>
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<td>295</td>
</tr>
<tr>
<td></td>
<td>25.4</td>
<td>24.6</td>
</tr>
<tr>
<td><strong>Cancer risk factor recognition (out of 11)</strong></td>
<td>5.9</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>2.7</td>
<td>2.7</td>
</tr>
</tbody>
</table>
5.3.2.2 Interest in lifestyle advice at cancer screening

About two-thirds of participants were interested in receiving advice about diet (67.3%, n=799), weight (65.9%, n=782), or physical activity (61.5%, n=727) during future cancer screening appointments (Table 5.5). Around one in five people were interested in receiving advice about smoking cessation (16.9%, n=199), and a third of the sample were interested in information about alcohol consumption (31.6%, n=374).

5.3.2.3 Sociodemographic determinants of interest in lifestyle advice at cancer screening

The odds of reporting interest in advice about alcohol decreased with increasing age (OR 0.98, 95% CI 0.97-1.00, p=0.007). Non-White participants were more likely to be interested in dietary and physical activity advice, compared with White participants. Interest in dietary advice was expressed by 80.5% of non-White participants, compared with 65.5% of White participants (OR 2.10, 95% CI 1.27-3.45, p=0.004). Similarly, 78.9% of non-White participants expressed interest in advice about physical activity compared with 59.2% of White participants (OR 2.34, 95% CI 1.42-3.85, p=0.001). There were no associations between gender or education and interest in any of the five topics of advice (Table 5.6).

5.3.2.4 Psychological determinants of interest in lifestyle advice at cancer screening

Cancer risk factor awareness was positively associated with interest in advice about most lifestyle topics (Table 5.6). With each additional cancer risk factor recognised, the odds of being willing to receive advice about diet (OR 1.09, 95% CI 1.03-1.14, p=0.001), weight (OR 1.11, 95% CI 1.05-1.17, p<0.001), physical activity (OR 1.07, 95% CI 1.02-1.12, p=0.008), and alcohol consumption (OR 1.12, 95% CI 1.06-1.18, p<0.001) increased. Cancer risk factor awareness was not associated with willingness to receive advice about smoking cessation (OR 1.09, 95% CI 1.01-1.17, p=0.018). Comparative cancer risk perceptions were not strongly associated with interest in any of the topics of lifestyle advice.

A sensitivity analysis explored whether knowledge of individual risk factors was associated with interest in information about their corresponding topics of advice, mutually adjusted for age, gender, ethnicity, educational attainment, comparative cancer risk, and current health behaviour.
People who recognised low fruit and vegetable consumption as a risk factor for cancer were more likely to want dietary advice at cancer screening (OR 1.48, 95% CI 1.10-1.98, p=0.009). Recognition of alcohol consumption as a risk factor for cancer was associated with interest in advice about alcohol consumption (OR 1.70, 95% CI 1.30-2.22, p<0.001). Recognition of overweight (OR 1.12, 95% CI 0.84-1.51, p=0.440), low physical activity (OR 1.24, 95% CI 0.95-1.62, p=0.118), and smoking (OR 1.18, 95% CI 0.70-2.03, p=0.530) were not associated with interest in their respective topics of advice.
## Table 5.5 Interest in different topics of lifestyle advice at cancer screening

<table>
<thead>
<tr>
<th></th>
<th>Diet (n=1187)</th>
<th>Weight (n=1187)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Very interested</td>
<td>319</td>
<td>26.8</td>
</tr>
<tr>
<td>Somewhat interested</td>
<td>293</td>
<td>24.7</td>
</tr>
<tr>
<td>A little interested</td>
<td>187</td>
<td>15.8</td>
</tr>
<tr>
<td>Not at all interested</td>
<td>275</td>
<td>23.1</td>
</tr>
<tr>
<td>Not applicable</td>
<td>114</td>
<td>9.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Physical activity (n=1181)</th>
<th>Smoking (n=1177)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Very interested</td>
<td>281</td>
<td>23.8</td>
</tr>
<tr>
<td>Somewhat interested</td>
<td>263</td>
<td>22.3</td>
</tr>
<tr>
<td>A little interested</td>
<td>183</td>
<td>15.5</td>
</tr>
<tr>
<td>Not at all interested</td>
<td>329</td>
<td>27.9</td>
</tr>
<tr>
<td>Not applicable</td>
<td>126</td>
<td>10.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Alcohol (n=1182)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Very interested</td>
<td>105</td>
<td>8.9</td>
</tr>
<tr>
<td>Somewhat interested</td>
<td>142</td>
<td>12</td>
</tr>
<tr>
<td>A little interested</td>
<td>126</td>
<td>10.7</td>
</tr>
<tr>
<td>Not at all interested</td>
<td>416</td>
<td>35.2</td>
</tr>
<tr>
<td>Not applicable</td>
<td>392</td>
<td>33.2</td>
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</table>
Table 5.6 Sociodemographic, psychological and behavioural predictors of interest in advice about diet, weight, physical activity, smoking, and alcohol consumption at cancer screening (adjusted logistic regression models)

<table>
<thead>
<tr>
<th>Diet</th>
<th>Weight</th>
<th>Physical activity</th>
<th>Smoking</th>
<th>Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=1086)</td>
<td>(n=923)</td>
<td>(n=1081)</td>
<td>(n=1078)</td>
<td>(n=1064)</td>
</tr>
<tr>
<td>OR (95% CI)</td>
<td>p</td>
<td>OR (95% CI)</td>
<td>p</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Age</td>
<td>0.99 (0.98-1.00)</td>
<td>0.147</td>
<td>0.99 (0.98-1.00)</td>
<td>0.100</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>REF</td>
<td>-</td>
<td>REF</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>1.04 (0.70-1.55)</td>
<td>0.846</td>
<td>1.16 (0.75-1.80)</td>
<td>0.497</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>REF</td>
<td>-</td>
<td>REF</td>
<td>-</td>
</tr>
<tr>
<td>Non White</td>
<td>2.10 (1.27-3.45)</td>
<td>0.004</td>
<td>1.41 (0.83-2.40)</td>
<td>0.205</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree level or above</td>
<td>REF</td>
<td>-</td>
<td>REF</td>
<td>-</td>
</tr>
<tr>
<td>below degree level</td>
<td>1.07 (0.79-1.46)</td>
<td>0.656</td>
<td>0.93 (0.67-1.30)</td>
<td>0.676</td>
</tr>
<tr>
<td>Current or future screening attender</td>
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<td></td>
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</tr>
<tr>
<td>Current</td>
<td>REF</td>
<td>-</td>
<td>REF</td>
<td>-</td>
</tr>
<tr>
<td>Future</td>
<td>1.31 (0.86-2.01)</td>
<td>0.204</td>
<td>1.45 (0.92-2.29)</td>
<td>0.110</td>
</tr>
<tr>
<td>Comparative cancer risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same</td>
<td>REF</td>
<td>-</td>
<td>REF</td>
<td>-</td>
</tr>
<tr>
<td>Lower</td>
<td>1.48 (1.07-2.05)</td>
<td>0.018</td>
<td>1.14 (0.81-1.60)</td>
<td>0.461</td>
</tr>
<tr>
<td>Higher</td>
<td>1.37 (0.92-2.03)</td>
<td>0.118</td>
<td>1.02 (0.66-1.56)</td>
<td>0.937</td>
</tr>
<tr>
<td>Meets guidelines for behaviour in question</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>REF</td>
<td>-</td>
<td>REF</td>
<td>-</td>
</tr>
<tr>
<td>No</td>
<td>0.96 (0.72-1.27)</td>
<td>0.762</td>
<td>2.53 (1.88-3.42)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number of cancer risk factors recognised</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.09 (1.03-1.14)</td>
<td>0.001</td>
<td>1.11 (1.05-1.17)</td>
<td>&lt;0.001</td>
<td>1.07 (1.02-1.12)</td>
</tr>
</tbody>
</table>
5.3.2.5 Behavioural determinants of lifestyle advice at cancer screening

Participants not meeting recommendations for the respective health behaviours were more likely to be interested in advice about weight, physical activity, smoking and alcohol consumption (Table 5.6; Figure 5.3). Three-quarters of participants in the overweight category expressed an interest in advice about keeping a healthy weight (74.6%) compared with 59.6% of participants classified as not overweight (OR 2.53, 95% CI 1.88-3.42, p<0.001). Interest in advice about physical activity was expressed by 65.8% of people not taking part in 30 minutes of moderate activity five times per week, compared with 52.0% of people who were classified as physically active (OR 1.54, 95% CI 1.17-2.02, p=0.002). Smokers had greater odds of interest in smoking cessation advice (59.7%) compared with non-smokers (9.1%; OR 16.23, 95% CI 10.70-24.62, p<0.001). Participants who exceeded 14 alcoholic units per week were more likely to report interest in advice about alcohol consumption (49.3%) when compared with participants meeting alcohol consumption guidelines (29.2%; OR 2.35, 95% CI 1.56-3.53, p<0.001).  

Figure 5.3 Proportion of participants willing to receive each type of lifestyle advice, by adherence to behavioural guidelines

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18 ORs are presented adjusted, proportions are presented unadjusted.

19 A sensitivity analysis was conducted which excluded participants who felt the advice would not be applicable to them, and results were broadly unchanged. However, for interest in advice about PA and alcohol, meeting the guidelines was not as strongly associated, and for interest in dietary advice, those who perceived themselves to be at lower risk were more likely to be interested in advice.
5.4 Discussion of studies 3a and 3b

In line with the second aim of this thesis, studies 3A and 3B sought to determine levels of willingness to receive information about lifestyle within existing NHS cancer screening programmes and to understand preferences for advice delivered in this context. In this large, population-based sample of English adults, the majority of people intending to attend NHS cancer screening programmes were willing to receive lifestyle advice, even if further investigations were required. A minority of people reported that the provision of advice would deter future screening participation. Preferences for the delivery of lifestyle advice were identified. Participants were willing to receive advice about a range of lifestyle factors and preferred to receive this advice at the screening appointment itself or with the results. Several sociodemographic, behavioural and psychological determinants of receptivity to advice were identified, which may help the development of interventions developed within this context.

The high proportion of people willing to receive lifestyle advice at cancer screening observed within our study (79-82%) is comparable to previous findings (Fisher et al., 2007; Sriphanlop et al., 2018). A number of sociodemographic determinants of willingness to receive lifestyle advice were identified. In the FS scenario, women were more likely to express willingness to receive lifestyle advice compared with men. This is in line with previous research suggesting men are less likely to engage in health-promoting behaviours, and help-seeking than women (Courtenay, 2000; Galdas, Cheater, & Marshall, 2005). This is also mirrored by the most recent Health Survey for England data which suggests men are more likely to be affected by overweight, consume fewer portions of fruits and vegetables and consume more alcoholic units per week than women (NHS Digital, 2018b). Almost 90% of women were interested in lifestyle advice at FS, compared with around 75% of men. Women’s interest in lifestyle advice at bowel screening may be higher than for breast and cervical screening (~79%); however the reasons for this are unknown. The sample size of women in the bowel screening scenario (n=161) was considerably smaller than for the cervical screening scenario (n=768), due to the screening criteria for these screening programmes and the sample selection criteria in this
survey. Therefore, it may be beneficial to confirm this finding with a larger sample of FS intenders.

Willingness to receive advice at cervical screening was greater among participants who reported education at degree level or above. However, there were no associations between educational attainment and interest in individual topics of lifestyle advice in study 3B. The link between education and health behaviour is well established (Cutler & Lleras-Muney, 2010; Pampel, Krueger, & Denney, 2010). Except for alcohol consumption, cancer risk behaviours are more prevalent among populations of lower socioeconomic position (SEP; Stringhini et al., 2011). Non-White women intending to attend cervical screening were more likely to be willing to receive lifestyle advice than white women (study 3A). In addition, non-White participants who intended to participate in cancer screening in the future were more likely to report interest in information about diet, physical activity and smoking cessation, when compared with white participants (study 3B). Previous research has found ethnic minority women less likely to participate in screening (Moser et al., 2009). This may suggest that non-White participants who do participate in cancer screening may be particularly open to offers of other cancer prevention services and advice. Additionally, non-White participants may see cancer screening as an opportunity to address information needs that are not currently being met elsewhere. Only a small proportion of our sample was non-white. Therefore these results need to be interpreted cautiously and replicated in more ethnically diverse samples.

Current health behaviour was associated with interest in advice about physical activity, weight, smoking and alcohol consumption at cancer screening. This suggests that a tailored approach to intervention design, which takes current behaviour into consideration, may be appropriate in this setting. Tailored advice has been delivered within the context of colorectal cancer screening, and has been successful at increasing reported fruit and vegetable consumption but did not increase physical activity or reduce alcohol consumption (Baker & Wardle, 2002; Robb et al., 2010). Tailoring may be particularly important for less prevalent behaviours, such as smoking and excessive alcohol consumption. Interestingly, interest in advice about alcohol consumption reduced with increasing age (Study 3B). This should be considered when
designing behavioural programmes for the screening context as English adults aged 65 and over drink more frequently younger age groups (Office for National Statistics, 2017).

Cancer risk factor awareness and risk perceptions were explored as potential determinants of interest in advice about individual topics of lifestyle advice at cancer screening (study 3b). Risk perceptions were not strongly associated with interest in any of the topics of advice. However, a single-item measure of comparative cancer risk was used (Dillard et al., 2012; Zajac et al., 2006). Further research is needed to understand whether other aspects of risk, such as affective or experiential risk perceptions are associated with interest in lifestyle advice at cancer screening (Ferrer et al., 2016). Cancer risk factor awareness was positively associated with willingness to receive advice about diet, weight, physical activity, and alcohol consumption. Previous research has highlighted the importance of providing convincing evidence about the link between lifestyle and cancer risk within cancer screening settings (Stead et al., 2012). This suggests that interventions delivered alongside cancer screening may benefit from increasing awareness of cancer risk factors.

In the cervical screening scenario, a greater proportion of participants were willing to receive advice when respondents considered it as part of a scenario where their results required further investigations. This effect was not observed for the breast and bowel screening samples, perhaps due to smaller sample sizes within these scenarios. It is important to consider how screening results may impact receptivity to advice in cancer screening contexts. Evidence exploring spontaneous behaviour change following cancer screening participation is suggestive of abnormal screening results promoting greater changes to smoking cessation in the context of lung screening (Slatore et al., 2014). How best to integrate screening results into behaviour change depends largely on the timing relative to the screening appointment. If delivered at the screening appointment, it would not be possible to integrate breast and cervical screening results into the intervention. However, the identification of polyps at FS screening may mean that patients are given an indication whether further investigations might be required during the appointment.
Most participants in study 3A indicated they would like to receive lifestyle advice at the screening appointment itself. Other research suggests the timing of interventions delivered in the context of cancer screening is important (McBride et al., 1999). It has also been reported that people attending screening would prefer advice to be given by an expert, such as a health professional (Fisher et al., 2007). This is in line with previous conceptualisations of the teachable moment as potentially reliant on interactions between patients and clinicians (Lawson & Flocke, 2009). Future work should, therefore, investigate how practicable it would be to deliver lifestyle advice within population cancer screening services, who would be best placed to deliver this advice, and how to join this up with screening participants’ preferences.

Previous research suggests that health care professionals may be reluctant to deliver advice about topics such as weight, fearing that this advice may cause distress to patients (Michie, 2007). Within the screening context, healthcare professionals have also expressed concerns about eliciting feelings of guilt when discussing topics such as alcohol consumption (Sinclair et al., 2019). Reassuringly, three-quarters of overweight participants in our sample were willing to receive advice about weight as part of cancer screening services. In addition, half of people not meeting alcohol consumption guidelines were willing to receive advice about reducing alcohol consumption. This supports the finding that advice about weight in a primary care setting is considered appropriate and helpful by the majority of patients, and that interest in diet and weight advice at breast screening is greater among women affected by overweight (Aveyard et al., 2016; Fisher et al., 2007).

A key concern about the provision of lifestyle advice in the context of cancer screening programmes is the potential impact on future screening uptake (Sinclair et al., 2019). The proportion of participants who indicated they would be less willing to attend screening if lifestyle advice was provided was higher than previous estimates from breast screening clinics (1%; Fisher et al., 2007). In study 3A, 8% indicated they would be less willing to attend if lifestyle advice was provided. These two figures result in differing estimations of the impact on screening uptake. In 2017-18, 2.14 million women participated in the NHS breast screening programme in England (NHS Digital, 2019a). By Fisher and colleagues (2007) estimate, the
The provision of lifestyle advice could result in around 20,000 fewer women participating in breast screening annually. If 8% of would-be screening participants are deterred, the impact could be closer to 170,000 fewer women participating. One explanation for the difference in estimations of the impact of advice on screening uptake could be the difference in sampling methods. The sample reported in study 3A was drawn from a population survey, and included people intending to participate in cancer screening programmes. This sample are likely to differ to the general population of screening intenders, who comprise a proportion of people who will not attend screening due to an intention-behaviour gap. Within the sample analysed in study 3A, the proportion of people who indicated they would be deterred from attending cancer screening was small so it was not possible to explore sociodemographic associations of deterrence. However, it is important to understand whether the provision of lifestyle advice would widen screening inequalities by deterring lower SEP and ethnic minority populations.

Both study 3a and the study by Fisher and colleagues (2007) assessed the proportion of participants who would be more willing to participate in cancer screening if lifestyle advice was provided. Results from these studies suggest that the number of people less willing to participate in screening would be offset by the number of people more willing to participate. For example 34.4% of the breast screening sample in study 3a would be more willing to participate, compared with 7.0% who would be less willing to attend. This is reassuring and suggests the provision of lifestyle advice may constitute a novel way of improving screening uptake among some screening intenders. However, the positive and negative effects of lifestyle advice on screening uptake warrants further investigation.

5.4.1 Strengths

This was the first study to explore acceptability and preferences for lifestyle advice across multiple NHS cancer screening programmes. The sampling method resulted in a large sample that is broadly representative of the English population. Furthermore, this study assessed a range of issues around the delivery of lifestyle advice at cancer screening. For example, this study included items assessing the potential impact of lifestyle advice on screening uptake, which is a concern for healthcare professionals (Sinclair et al., 2019). The sociodemographic,
behavioural and psychological factors associated with willingness to receive lifestyle advice identified in study 3A and 3B may guide the development of interventions in screening settings, in addition to information about screening intenders’ preferences for the content and timing of advice.

5.4.2 Limitations

This research has a number of limitations. Firstly, participants were recruited using a population-representative survey, rather than directly from screening settings. This meant that the sample were selected based on their intention to participate in future cancer screening. The proportion of people intending to attend screening, across the modalities, was higher than actual uptake rates. High cancer screening intentions are not unusual and overestimation of intention to perform a behaviour is known as the intention-behaviour gap (Sheeran, 2002). This intention-behaviour gap means it is likely that a number of people intending to participate in cancer screening will not take up the offer when invited. Willingness to receive lifestyle advice may differ between people who intend to participate in screening, and people who actually participate. Within our sample, intention to attend FS was 87%, which is in line with intention rates reported in other English samples (Robb, Power, Atkin, & Wardle, 2008). However, actual FS uptake in England is around half of this figure (McGregor et al., 2016). Sociodemographic differences have been reported consistently for screening uptake. However, these differences may not be found when looking at screening intention (Robb et al., 2008), therefore, this research may not accurately reflect sociodemographic differences in intentions or desire for lifestyle advice.

As well as a likely intention-behaviour gap for screening, the sample appear to be more health-conscious than would be expected in the general population. For example, around half of our sample had a BMI >25, compared with 61% of English adults in the general population (NHS Digital, 2018b). The health behaviours of screening attenders have been found to differ from non-attenders, which may also be the case for the screening intenders within our sample (Shapiro, Seeff, & Nadel, 2001). In addition, survey respondents may also be healthier than the general population (Keyes, Rutherford, Popham, Martins, & Gray, 2018).
A further limitation is that this study was based on hypothetical scenarios around English cancer screening programmes. Scenarios presented in this research included attending cancer screening, receiving an abnormal screening result, and receiving lifestyle advice alongside screening. Hypothetical scenarios are likely to differ from appraisals of information delivered in a real-life screening setting. This may be a particular issue for FS screening, as this is a relatively new screening programme, which nobody in the sample would have been invited to participate in. However, the similar rates of willingness to receive lifestyle advice in this sample, compared with a sample recruited directly from breast screening clinic is reassuring (Fisher et al., 2007).

This study is limited by the choice and wording of the measures used. Education level was used as a proxy of SES. While aiding the interpretation of results, this measure may not accurately reflect a person’s socioeconomic position. The use of dichotomised education and ethnicity variables also impact the interpretation of results. For example, we dichotomised education based on whether someone had attained education at degree level or above, which may have masked differences between groups educated below degree level.

The wording of the questions may also have influenced responses. We used diet and physical activity as examples of lifestyle advice when asking about interest, different examples such as smoking cessation may have prompted a different response. Measures of health behaviour used in study 3b may also impact the findings. All health behaviour measures were self-reported, which may be subject to a number of biases (Newell, Girgis, Sanson-Fisher, & Savolainen, 1999). For example, we used fruit and vegetable consumption as a proxy of diet, however the accuracy of self-reported dietary data has been questioned (Subar et al., 2015).

The selection of measures was informed, in part, by attempts to limit participant burden and space constraints within the wider survey.

Studies 3A and 3B selected different samples from the same population-representative survey. In study 3b, questions relating to interest in specific topics of lifestyle advice were administered to a general sample of people intending to attend any cancer screening programme in the future. The nature of omnibus surveys means that there is limited capacity
to include questions, so the decision was made not to ask about interest in topics of advice for each cancer screening programme individually. Therefore it is not known whether interest in different topics of advice may vary between screening modalities. In study 3A, willingness to receive advice about alcohol consumption may vary depending on the leniency of the recommendation used. Some participants will have answered questions relating to more than one screening programme, which may impact responses. This effect is difficult to determine because the number of programmes a person is eligible for is confounded by gender and age.

5.4.3 Directions for future research

Firstly, it is unknown whether participants would be willing to accept the same kind of lifestyle advice in other screening settings, such as lung cancer screening, which often already involve a smoking cessation advice component. Given the increasing interest in the implementation of lung cancer screening programmes, it is important to consider screening participants’ preferences for advice delivered in conjunction. Furthermore, as the results of study 3A suggest the provision of lifestyle advice could negatively impact screening attendance, it would be prudent to see if a similar effect is reported among potential lung screening participants.

5.4.4 Conclusion

This study was the first to investigate interest in lifestyle advice across three English cancer screening programmes. Interest was high, regardless of the outcome of a person’s screening result. However, our results suggest a minority who would otherwise attend screening might be put off if lifestyle advice were offered. The majority of people who intend to participate in cancer screening would be willing to receive advice about common cancer risk factors at this time. Advice appears to be particularly acceptable to people who do not meet recommendations for health behaviours. Increasing cancer risk factor awareness and tailoring advice to current behaviour may provide an important basis for the development of interventions within the cancer screening setting. Future research should explore the acceptability of lifestyle advice within new screening programmes and modalities, where the implementation of lifestyle advice may be more practicable.
Chapter 6. Lung cancer screening as an opportunity to provide healthy lifestyle advice: public acceptability and preferences for lifestyle advice (Study 4)

6.1 Introduction

Studies 3A and 3B found the majority of people intending to attend breast, bowel and cervical screening are willing to receive advice about a range of lifestyle topics alongside the existing NHS cancer screening programmes. While this is encouraging, there are a number of challenges to integrating behaviour change interventions into existing screening programmes, such as time and other resources. The implementation of new screening programmes may provide opportunities to deliver behaviour change advice to large populations, integrated into the screening programme from its inception. In line with the second aim of this thesis, this chapter will explore the acceptability of lifestyle advice alongside lung cancer screening, as well as preferences for the content and delivery of advice.

The recent European position statement on lung cancer screening recommends low dose computed tomography for high-risk populations, with smoking cessation advice offered to smokers (Oudkerk et al., 2017). Following the recommendation for LDCT lung screening, a number of European countries may consider the implementation of this screening programme in the near future. Unique to lung screening, there is consensus on the delivery of smoking cessation advice to attendees who are current smokers (Joseph et al., 2018; Oudkerk et al., 2017); a similar consensus has not yet been reached for the provision of behaviour change support alongside other cancer screening programmes. Combining cancer screening and behaviour change advice could be cost-effective and provide the greatest impact on mortality (Field, Hannon, Duffy, & Baldwin, 2013; Ilbawi & Anderson, 2016; Tanner et al., 2016), with
the addition of smoking cessation interventions alone estimated to improve the cost-effectiveness of lung screening by 20-45% (Villanti, Jiang, Abrams, & Pyenson, 2013).

Lung screening programmes may provide an opportunity to deliver lifestyle advice to large, high-risk populations. Data from lung screening trials suggest smoking prevalence is likely to be higher among lung screening attendees compared with the general population (Aberle et al., 2010; Field, Duffy, Baldwin, Whynes, et al., 2016; Horeweg et al., 2014); within the UK Lung Cancer Screening (UKLS) pilot trial, 38.3% of the screening arm were current smokers (Field, Duffy, Baldwin, Whynes, et al., 2016). As well as an increased smoking prevalence among lung screening populations, this group may be more likely to engage in a range of cancer risk behaviours. Smokers are more likely to consume alcohol, exhibit poorer dietary behaviours, and be physically inactive (Meader et al., 2016; Noble et al., 2015). The lung screening population may, therefore, stand to benefit considerably from a multiple risk factor approach to behaviour change.

To date, research exploring lung screening as an opportunity for behaviour change interventions has focused solely on smoking cessation. Despite consensus on the implementation of smoking cessation interventions alongside lung screening, the optimal approach for smoking cessation in this setting remains unclear (Iaccarino et al., 2019). A recent systematic review identified nine smoking cessation interventions within the lung screening context, of which just one of five RCTs found increased smoking cessation in the intervention group compared with control groups. The authors concluded that more intensive interventions, such as multiple smoking cessation counselling sessions or pharmacotherapy, may be needed to assist smoking cessation alongside lung screening. The review also discovered 11 ongoing registered trials of smoking cessation interventions at lung screening, highlighting increasing interest in developing effective interventions within this setting.

While there is a growing body of research exploring the effectiveness of smoking cessation interventions alongside lung screening, there has been limited research to understand patients’ preferences for how this advice is delivered, such as the content or timing. There has been a single study investigating preferences for mode of intervention delivery (Carter-
Harris, Schwindt, Bakoyannis, Ceppa, & Rawl, 2018). A range of intervention formats were explored in hypothetical scenarios presented to 159 screening-eligible current smokers. Modes of intervention delivery were dichotomised into traditional (e.g. face-to-face, or telephone counselling) and digital (e.g. social media or internet-based programmes). The authors did not report overall levels of preference for each of the modes of intervention. In addition, it is not clear whether people who did not respond or did not want to receive either topic of advice were excluded from analyses, making it difficult to draw conclusions about overall levels of willingness to receive advice about smoking cessation at lung screening. However, univariate and multivariate models found that odds of interest in digital formats were greater among White participants (41.0% preferred digital format) compared to non-White participants (14.6% preferred digital format). This suggests there may be important sociodemographic factors which influence participant’s willingness to receive lifestyle advice at screening.

There is a concern that providing lifestyle advice at cancer screening may negatively impact uptake. Lung cancer screening uptake has been low in trials, particularly among current smokers and socioeconomically deprived populations (McRonald et al., 2014; Quaife, Ruparel, et al., 2016). It is, therefore, important to ensure that any interventions delivered alongside lung cancer screening do not widen inequalities through negatively impacting uptake among socioeconomically deprived groups. Furthermore, inequalities could be exacerbated if advice is less acceptable among socioeconomically deprived groups. Chapters 3A and 3B highlight a range of sociodemographic, behavioural and psychological determinants of interest in lifestyle advice in existing cancer screening programmes. It is essential to consider these factors in relation to populations of lung screening participants.

Research exploring preferences for lifestyle advice at lung screening is limited. Furthermore, the scope of research to date has been restricted to smoking cessation as the sole target for interventions. This study builds upon studies 3A and 3B by exploring lung cancer screening as a teachable moment for behaviour change interventions. Using a nationally representative sample of English adults and hypothetical lung screening scenarios, this research is the first
to explore interest in information about a range of cancer risk factors alongside lung cancer screening. The potential impact of lifestyle advice on future screening uptake was explored, as well as determinants of interest in lifestyle advice at lung cancer screening, and people’s preferences for the timing and topics of advice.

6.2 Methods

6.2.1 Design

Data were collected using the Smoking Toolkit Study, a monthly cross-sectional survey of smoking trends in England (Fidler et al., 2011). Approximately 1,800 participants aged over 16 years are recruited each month. Face to face computer-assisted interviews were conducted by market research agency Ipsos MORI as part of an omnibus survey. To recruit a sample that is broadly representative of the English general population, random location sampling is used. More than 165,000 locations, each comprising around 300 households, are stratified according to ACORN criteria\(^{20}\). A selection of areas are visited by interviewers, who interview one adult per household, filling quotas based on sex, age, working status and housing tenure. Informed consent is obtained prior to each interview.

The survey includes a number of core modules, such as smoking status, motivation to smoke, and nicotine dependence which are included in each wave of data collection. For the present study, additional measures relating to the acceptability of lifestyle advice were added to seven waves of data collection between May-November 2017. A total of 11,899 participants were surveyed during the seven-month period. Ethical approval for the data presented in this study was granted by the University College London Research Ethics Committee (REF: 5210/002).

6.2.2 Participants

Criteria for the inclusion of participants into this study were based on age, smoking history, previous cancer diagnoses, and intention to attend lung screening if invited. The age range of participants was based on the UK Lung Cancer Screening Trial, which included adults aged 50-75 (Field et al., 2011). It was not possible to calculate individuals’ lung cancer risk. This is

\(^{20}\) [https://acorn.caci.co.uk/](https://acorn.caci.co.uk/)
partly due to a lack of consensus about the best way to estimate lung cancer risk (Gray, Teare, Stevens, & Archer, 2016), and the practicalities of calculating this within a survey. Therefore, the sample was limited to participants who smoked, or who had quit smoking within the last 5 years. Participants were included in analyses if they stated they would attend lung cancer screening if invited and were excluded if they had a previous cancer diagnosis.

6.2.3 Measures

**Sociodemographic variation:** Data were collected for four sociodemographic variables: age, gender (male / female). For ethnicity, participants were categorised as white if they self-identified as White British, White Irish, White Gypsy or Traveller, or White other. All other participants were categorised as non-White. Educational attainment was used as a marker of social position. Participants were classified as reporting education to degree level or above (Bachelor’s degree or equivalent / NVQ4, masters/PhD or equivalent) or education below degree level (GCSE/O-LEVEL/CSE, vocational qualifications / NVQ1/2, A-LEVEL or equivalent / NVQ3, Other, No formal qualifications, Still studying).

**Intention to participate in lung cancer screening:** Participants were provided with a brief description of CT lung screening prior to questions relating to lung screening: ‘A new screening test is being developed to find lung cancer at an early stage. It would use a type of x-ray called a chest CT scan. The scan takes pictures of the lungs which are then checked for the early signs of lung cancer. The screening test would be offered to people who smoke or used to smoke, not people going to their GP with symptoms of lung cancer.’

Intention to attend lung screening was assessed by responses to: ‘If your GP invited you to have a lung cancer screening test as part of an NHS lung cancer screening programme, would you take up the offer?’, dichotomised into yes (Yes, definitely; Yes, probably) and no (No, probably not; No, definitely not).

**Willingness to receive lifestyle advice at lung cancer screening:** Lung screening intenders were asked: Would you be willing to receive advice about making healthy lifestyle changes (for example, diet or physical activity) as part of a lung screening programme?’ An additional
question assessed interest in lifestyle advice in the event of a screening result which required further investigations: ‘Would you be willing to receive lifestyle advice if your screening result suggested you needed to have further investigations?’ Both responses were categorised into willing (Yes, definitely; Yes, probably), or not willing (No, probably not; No, definitely not; Not sure). Participants were able to refuse to answer both questions. Refusals were coded as missing.

**Impact of lifestyle advice on lung screening participation:** Participants were asked: ‘If you knew you would receive advice about lifestyle (for example, diet or physical activity) as part of a lung cancer screening programme, would this affect your willingness to attend lung screening?’ (Yes, I would be more willing to attend; Yes, I would be less willing to attend; No, it would not affect my willingness to attend). Participants were able to refuse to answer or select ‘don’t know’. These participants were coded as missing.

**Willingness to receive different types of lifestyle advice at lung screening:** Lung screening intenders who were willing to receive lifestyle advice at lung screening were asked about their interest in five topics: ‘If you were to attend lung cancer screening in the future, which of the following, if any, would you be interested in receiving information or advice about?.. How to have a healthy diet / maintain a healthy weight / increase your physical activity / to stop smoking / reduce your alcohol consumption / none of these.’ (Yes /No). One item assessed preferred timing of advice: ‘When would you prefer to receive lifestyle advice as part of a lung screening programme?’ (before I attend the lung screening appointment; at the same time as my screening appointment; with my screening results; 2-4 weeks after attending screening; 1-3 months after attending screening; more than 3 months after attending screening). For this section, participants were able to refuse to answer the question or select ‘don’t know’. These participants were coded as missing.

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21 An additional response option ‘Before I attend the lung screening appointment’ was added to this item, following study 3, upon consideration that some people may prefer to receive advice before the appointment (e.g. with their invitation).
Current health behaviours: As in study 3, five health behaviours were assessed. Fruit and vegetable consumption were measured using two items (Cappuccio et al., 2003): ‘Over the past month, how many portions of fruit / vegetables did you usually eat?’ Participants who consumed five or more portions daily were categorised as meeting guidelines. Body Mass Index (BMI) was calculated from self-reported height and weight. Implausible BMI data were excluded (BMI < 14 / > 50; n=6). BMI was dichotomised to ≥25 (overweight) vs <25 (not overweight). Physical activity was assessed using one item: ‘In the past week on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?’ (Milton et al., 2011; Milton et al., 2013). Participants taking part in physical activity on five or more days per week were classified as meeting guidelines. Smoking status was assessed using two items: ‘Do you smoke at all nowadays?’ and ‘Did you stop smoking completely in the last five years?’ Alcohol consumption was measured using the AUDIT-C questionnaire (Department of Health, 2013). Three questions assessed the frequency of alcohol consumption, quantity of alcohol consumed, and frequency of binge drinking (6 or more units on a single occasion if female, 8 or more units if male). As per the scoring criteria for the AUDIT-C, participants scoring five or more were categorised as ‘increasing or higher risk drinkers’. For all measures of health behaviours, participants were able to refuse to answer or select ‘don’t know’. Participants who selected these options were coded as missing.

Cancer risk factor awareness: Cancer risk factor awareness was assessed using an 11-item scale (Stubbings et al., 2009). Participants were shown 11 cancer risk factors (e.g. smoking, overweight) and were asked to select ‘Which of the following, if any, do you personally think increase a person’s chances of developing cancer?’ Participants were given a score out of 11. Participants who refused to answer this question, or selected ‘don’t know’ were coded as missing.

6.2.4 Analyses
Descriptive analyses estimated willingness to receive information around the time of screening, the effect of information provision on screening uptake and preferences for
information timing and topics. A McNemar’s test was used to investigate differences between interest in advice in general, and if results would require further investigation. Corrected Pearson Chi-squared was used to investigate differences in proportions of people willing to receive each topic of advice by current health behaviour. A corrected (design-based) version Pearson Chi-squared is appropriate in this instance as the analyses were conducted on weighted data. Two binary logistic regression models were used to identify determinants of interest in advice, and determinants of being put off attending screening if advice were delivered. Both logistic regression models were mutually adjusted for gender, ethnicity, education, age and cancer risk factor awareness. Weights were applied to unadjusted analyses to account for response bias. Weights were calculated by Ipsos MORI using gender, age, social grade, region, working status, housing tenure and ethnicity. Analyses were conducted in Stata/SE 14.2.

### 6.3 Results

#### 6.3.1 Sample characteristics

Of those interviewed, 685 were current smokers or recent quitters aged 50-75. Participants were excluded from analyses if they had received a previous cancer diagnosis (n=46; 6.7%), or indicated they would not attend lung screening if invited (n=174; 25.4); six participants (0.9%) met both exclusion criteria leaving a final sample of 459 (67.0%; Table 6.1). The mean age was 59.4 years. Half were male (51.4%), the majority were White (93.9%), and educated below degree level (83.9%). Most participants were current smokers (74.4%), were overweight (56.8%), and did not meet guidelines for fruit and vegetable consumption (63.1%) and physical activity (60.9%). One-third of participants (32.2%) were identified as increasing or higher risk drinkers. Participants recognised an average of 3 out of 11 cancer risk factors.
## Table 6.1 Weighted and unweighted sociodemographic characteristics of the sample

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<th>Weighted (n=459)</th>
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<td></td>
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<td>%</td>
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<tr>
<td>Former</td>
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<tr>
<td>Lower risk drinker</td>
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<td><strong>Age</strong></td>
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<td>M</td>
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<td>7.2</td>
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<td>(out of a possible score of 11)</td>
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<td>2.7</td>
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6.3.2 Willingness to receive lifestyle advice at lung cancer screening

Two thirds (63.6%, n=292) were willing to receive lifestyle advice at lung cancer screening. Non-White ethnicity and greater cancer risk factor awareness were associated with greater willingness to receive advice at this time (Table 6.2). Compared with 61.5% (n=236) of White participants, 93.0% (n=26) of non-White participants were willing to receive lifestyle advice at lung cancer screening, although confidence intervals were wide (OR 7.0, 95% CI 1.6-30.4, p=0.009). Odds of interest in advice increased with each additional cancer risk factor identified (OR 1.10, 95% CI 1.0-1.2, p=0.023). In a scenario where screening required further investigations, 83.1% (n=381) indicated they would be willing to receive lifestyle advice at lung cancer screening. A greater proportion of people were willing to receive advice in this scenario, compared with during lung screening in general (McNemar’s Chi²=123.77, p<0.001).

<table>
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<tbody>
<tr>
<td>Men</td>
<td>Ref</td>
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<tr>
<td>Women</td>
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<table>
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<tr>
<th>Ethnicity</th>
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<tbody>
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<td>White</td>
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<tr>
<td>Non-White</td>
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<tr>
<th>Education</th>
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<tr>
<td>Qualifications below degree level</td>
<td>0.96 (0.56-1.63)</td>
<td>0.872</td>
</tr>
</tbody>
</table>

| Age             | 0.99 (0.97-1.02)  | 0.663|
| Cancer risk factor awareness | 1.10 (1.01-1.19) | 0.023|
6.3.3 Impact of lifestyle advice on intention to participate in lung screening

Most lung screening intenders indicated the provision of lifestyle advice at screening would make no difference to their decision to attend (63.2%, n=289), or would make them more willing to attend if lifestyle advice was provided (22.9%, n=105). However, 13.9% (n=64) of participants indicated they would be less willing to attend screening if lifestyle advice was provided. When we dichotomised the sample into those who would find lifestyle advice off-putting vs those who would not, no determinants of being deterred from screening were identified (Table 6.3).

Table 6.3 Determinants of being put off attending lung screening if lifestyle advice were provided (n=472, adjusted model)

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>0.62 (0.36-1.07)</td>
<td>0.085</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Non-White</td>
<td>0.92 (0.30-2.79)</td>
<td>0.882</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree level or above</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Qualifications below degree level</td>
<td>1.61 (0.84-3.11)</td>
<td>0.154</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>0.97 (0.93-1.01)</td>
<td>0.128</td>
</tr>
<tr>
<td><strong>Cancer risk factor awareness</strong></td>
<td>0.95 (0.85-1.05)</td>
<td>0.311</td>
</tr>
</tbody>
</table>
6.3.4 Information preferences at lung cancer screening

The preferred timings for the delivery of lifestyle advice at lung cancer screening were at the screening appointment (37.7%, n=108), with the screening results (30.5%, n=87), and before the screening appointment (17.3%, n=50). Few people thought advice should be provided at a later date (2-4 weeks after attending screening =7.5%, n=22; 1-3 months after attending screening =5.2%, n=15; more than three months after attending screening =1.9%, n=5).

Of the five topics of advice, interest was highest for smoking cessation (41.0%, n=422, rising to 51.0% among current smokers) and dietary advice (40.5%, n=118). One-third of the sample were interested in advice about weight (32.4%, n=94) and physical activity (29.0%, n=84). One in ten participants (9.5%, n=28) were interested in advice about alcohol consumption. Interest in advice about smoking, diet, weight, and alcohol consumption was associated with meeting recommended guidelines for the behaviour in question, with non-adherent people more interested in the relevant advice (Figure 6.1).

![Figure 6.1 Proportion of people willing to receive each category of lifestyle advice, by current behaviour](image-url)
6.4 Discussion

In this large, nationally representative study of people potentially eligible for lung cancer screening, two-thirds were interested in receiving lifestyle advice in this context. This was the first study to determine interest in advice about a range of modifiable risk factors. Uniquely, this study also explored if the provision of lifestyle advice could affect screening attendance. My results suggest lung screening attenders may be interested in multiple topics of advice. However, not all topics of advice were endorsed to an equal extent. While the prospect of advice made some participants more willing to attend; a minority of participants reported the provision of lifestyle advice would make them less likely to attend lung screening.

Previous studies have evaluated smoking cessation interventions conducted alongside lung cancer screening programmes (Pineiro et al., 2016). However, this is the first study to estimate the proportion of lung screening-eligible participants who would be willing to receive lifestyle advice at lung screening. Therefore, it is not possible to compare the findings of this research with similar research in lung screening settings. Studies 3A and 3B estimated the proportion of breast, bowel and cervical screening intenders willing to receive lifestyle advice. Across the three screening programmes, approximately 85% of screening intenders were interested in receiving lifestyle advice. Interest in advice at lung screening (63%) appears to be lower compared with breast, bowel and cervical screening, but this could reflect the different ways the samples were selected for these studies. In studies 3A and 3B participants were selected based on age and gender, in accordance with current screening criteria for existing NHS cancer screening programmes. The sample for study 4 was selected based on age and smoking history, which means the profile of participants is likely to differ. However, if two-thirds of people are open to advice in practice, lung screening could still provide a considerable opportunity for cancer risk factor reduction.

A greater proportion of the sample were willing to receive lifestyle advice if their results required further investigations. This could signal the presence of a Health Certificate Effect among some screening participants, whereby advice is only viewed as relevant if participants receive an abnormal screening result. Furthermore, increased smoking cessation rates have
been observed among lung screening attendees with abnormal results, compared with attendees with normal screening results (Brain et al., 2017; Slatore et al., 2014). It is important to better understand how screening results are interpreted by screening participants and to ensure that people are motivated to address cancer risk behaviours regardless of their screening results.

Study 4 also assessed preferences for different topics of lifestyle advice delivered alongside lung cancer screening. The most commonly endorsed topics of lifestyle advice were smoking cessation (41%) and dietary advice (41%). However, there was interest in other topics of advice, including weight and physical activity. This is encouraging, as it suggests that lung cancer screening may provide an opportunity to address multiple cancer risk factors. Compared with study 3B, a greater number of lung screening intenders were willing to receive smoking cessation advice than participants intending to participate in existing NHS screening programmes. However, interest was lower for all other topics of advice. Interestingly, when looking only at participants not meeting behavioural guidelines, interest in all topics of advice was higher among participants in study 3B compared with study 4. For example, 59.7% of smokers in study 3B were willing to receive smoking cessation advice, compared with 51.1% of smokers in study 4.

New to study 4 was the addition of ‘before I attend the lung screening appointment’ when surveying participant’s preferred timing of lifestyle advice. Most participants wanted to receive information close to the screening appointment (before attending, during the appointment or with results). These results are broadly comparable with study 3A, where the most commonly preferred timing of advice was at the screening appointment. A recent qualitative study of socioeconomically deprived and heavy smoking communities reported that smoking cessation is likely to be expected alongside lung cancer screening. However, some participants felt that mentioning smoking cessation alongside the invitation could be off-putting (Quaife, Marlow, McEwen, Janes, & Wardle, 2017). It is important to consider the impact of the provision of lifestyle advice at different time points, as well as the efficacy of lifestyle advice at different time points.
Lung cancer screening uptake is low, particularly among current smokers and those from socioeconomically deprived populations (McRonald et al., 2014; Quaife, Ruparel, et al., 2016). Within our sample of people who intend to attend lung screening if invited, 14% indicated they would be less likely to participate if they knew lifestyle advice would be provided. While a minority, the potential impact that lifestyle advice may have on screening uptake for this group is important to understand, and so recommendations for future research are twofold. Firstly, future research should focus on identifying and characterising people who might be put off attending lung screening in a real-world context, and their reasons for being deterred. We did not identify any sociodemographic determinants of being deterred, although sample sizes were small meaning associations might have been missed. Clearer insights into this group may be found by recruiting a larger sample, or by purposively sampling people who would be deterred by the provision of lifestyle advice at lung screening. Secondly, future research should focus on understanding how information and interventions can be delivered in a way that minimises any negative effects on screening uptake.

A greater proportion of non-White participants were interested in lifestyle advice at lung screening, which has previously been reported among non-White cervical cancer screening intenders (study 3A). However, only a small proportion of our sample were non-White, highlighting the need for research with larger, more ethnically diverse samples. One other study has explored lung screening eligible participants’ preference for smoking cessation interventions in a hypothetical screening scenario, which reported great interest in digital formats among White participants compared to non-White participants (Carter-Harris et al., 2018). As study 4 did not explore preferred format for advice at lung screening, it is not possible to determine whether these results are at odds with the finding that non-White participants were more willing to receive lifestyle advice in general. Qualitative research may be a particularly useful tool for determining why non-White populations may be more receptive to advice in this setting, and for understanding the information needs and preferences of non-White lung screening attendees.
Study 4 included cancer risk factor awareness in a model identifying determinants of willingness to receive advice at lung screening. In keeping with previous research, greater cancer risk factor awareness was positively associated with interest in lifestyle advice at lung cancer screening (Anderson et al., 2013; Study 3B). Awareness is not part of the McBride et al. (2003) Teachable Moment Heuristic. However, knowledge is an important component of the COM-B model of behaviour, relating to the psychological capability to enact a behaviour (Michie et al., 2011). Increasing awareness could be a key aspect of engaging people with lifestyle advice within the cancer screening context. However, in line with the COM-B model, opportunity and motivation are also required to enact a behaviour.

6.4.1 Strengths

This was the first study to explore the acceptability and preferences for lifestyle advice at lung screening. The exploration of interest in advice about multiple cancer risk factors was particularly novel, as interventions delivered alongside lung screening have solely focused on smoking cessation. This study not only assessed the acceptability of advice, but also the potential impact of advice on screening uptake, and the desire for advice if participants’ results required further investigations. The data for this study were drawn from a survey broadly representative of the English population. Furthermore, the sample were likely to be somewhat representative of the high-risk group who might be invited to participate in an organised lung screening programme in England, based on their age and smoking history.

6.4.2 Limitations

This research has limitations, many of which are in common with studies 3A and 3B. As there is no established lung screening programme in England, hypothetical scenarios were used to gauge interest in lifestyle advice among lung cancer screening intenders. It is therefore likely that a proportion of our sample of screening intenders may not participate in lung screening if invited, due to an intention-behaviour gap (Sheeran & Orbell, 2000). Trials of lung screening settings could provide opportunities to assess acceptability and preferences in samples who have taken part lung screening. However trial samples also may not reflect the sample who would participate in an established screening programme.
The sample selection criteria used for this study may differ from the population invited to participate in lung screening if an organised programme is implemented in the future. Our criteria were based on the age-range used in a previous screening trial and smoking history (Field et al., 2011). Due to practical barriers, it was not possible to calculate lung cancer risk within the survey. Therefore, our sample may not represent the sample eligible for an eventual UK lung screening programme.

A further limitation of this research is the decision to exclude lung screening non-intenders from analyses. This decision was made in order to select the most appropriate sample to understand willingness to receive lifestyle advice at lung screening. However, the sample selection may not most appropriately explore the impact of lifestyle advice on screening uptake. It is possible that screening non-intenders may respond differently to the offer of lifestyle advice at lung cancer screening. Some screening non-intenders may be persuaded to attend by the offer of lifestyle advice, and other non-intenders may be even less likely to attend in this scenario. Future research should consider the impact of lifestyle advice for all screening invitees, rather than just the views of screening intenders.

Finally, the measures used within this study may limit our findings. The self-report measures used to assess health behaviour may be subject to response biases (Studies 3A & 3B). The choice and categorisation of sociodemographic covariates, such as the dichotomisation of ethnicity and the use of educational attainment as a marker of social position, may explain why few sociodemographic determinants of interest in advice were identified.

### 6.4.3 Directions for future research

Studies 3A, 3B, and four provide tentative support for the integration of advice about cancer risk reduction within English cancer screening programmes. While interest in advice was generally high across the studies, not all participants were willing to receive advice. Also, some participants indicated they would be deterred from future screening participation if lifestyle advice was provided. This research was conducted using hypothetical screening scenarios. It is, therefore, important to understand whether these views are held by people who have recently participated in cancer screening programmes. Qualitative research with screening
participants may offer in-depth insights into openness to lifestyle advice in the screening context and participants' preferences for how advice is delivered. Previous qualitative research has aimed to explore interest in cancer prevention advice at breast screening, but this has not been explored across other cancer screening programmes (Chambers et al., 2019; Conway et al., 2016; Mansour et al., 2019; Sinclair et al., 2019).

6.4.4 Conclusion

Lung cancer screening may offer an opportunity to provide advice about a range of behavioural cancer risk factors which may be prevalent among lung screening attendees. It is essential that future research builds upon the findings reported in studies 3 and 4 to understand individual differences in receptivity to lifestyle advice at cancer screening.
Chapters 5 and 6 indicate the majority of people intending to participate in cancer screening programmes in England would be willing to receive lifestyle advice in conjunction. However, a minority of people were not willing to receive lifestyle advice in this setting, and some participants felt the provision of lifestyle advice alongside cancer screening services would deter screening participation. The study presented in the current chapter builds upon the findings presented in Chapters 5 and 6, which highlighted the need to understand why the provision of lifestyle advice is acceptable for some screening attenders, but not for others. Understanding variation in the acceptability of lifestyle advice can aid in the development of interventions embedded in cancer screening services.

Qualitative research is an important step in intervention design, helping to develop an in-depth understanding of patient experience and preferences (Yardley, Morrison, Bradbury, & Muller, 2015). To date, few qualitative studies have attempted to understand the acceptability of interventions delivered alongside cancer screening. Studies generally report that lifestyle advice in screening settings is acceptable and appropriate (Chambers et al., 2019; Conway et al., 2016; Mansour et al., 2019; Sinclair et al., 2019). However, concerns have been raised about the negative psychological impact of interventions within screening contexts (Chambers et al., 2019; Conway et al., 2016; Mansour et al., 2019). In one focus-group study of 31 breast screening attendees, some women felt that the delivery of lifestyle advice at breast screening could raise anxiety, particularly for women who find breast screening to be a difficult experience. Furthermore, studies highlighted the potential for interventions about smoking at cervical screening (Mansour et al., 2019) and alcohol consumption at breast screening (Chambers et al., 2019) to prompt
feelings of stigma and blame. Previous research highlights the need for consistent, evidence-based information (Sinclair et al., 2019), delivered in a way that does not stigmatise screening participants for engaging in behaviours that increase their cancer risk (Chambers et al., 2019).

To date, qualitative research investigating the acceptability of lifestyle advice alongside cancer screening programmes has been limited to breast and cervical screening programmes. Within bowel screening programmes, qualitative research has explored colorectal adenoma diagnosis as an opportunity to provide cancer prevention advice (Stead et al., 2012). However, these samples are not reflective of the majority of bowel screening participants, who will receive normal screening results. Two of the studies exploring breast screening as an opportunity to provide lifestyle advice also included women attending symptomatic breast clinics (Chambers et al., 2019; Sinclair et al., 2019). There may be differences in the way that these two distinct groups of women view the delivery of lifestyle advice, although this was not explored in either study. It is, therefore, important to conduct in-depth research with samples invited to participate in NHS breast, bowel and cervical screening programmes.

This study was nested within a wider research project ‘Conversation Time’, which sought to explore the feasibility and potential predictors of openness to a conversation about physical activity alongside cancer screening. The study used Ecological Momentary Assessment (EMA), a method of capturing repeated measurements of behaviour or experience in real-time (Shiffman, Stone, & Hufford, 2008).

The detailed data produced by EMA can provide a basis for rich qualitative interviews. Data prompted interviews (DPIs) use participant data to guide discussion and explore the meaning of complex data (Kwasnicka, Dombrowski, White, & Sniehotta, 2015). There are a number of advantages to DPIs for both researchers and research participants. Participants benefit from being presented with visual memory aids to help guide their reflections on the topics presented. In the case of longitudinal EMA data, DPIs can help participants understand and articulate processes which may change over time. This is particularly important for the present study, which sought to capture changes in components of the Teachable Moment Heuristic (McBride et al., 2003) around the time of the cancer screening appointment. Researchers benefit from being able
to add context to quantitative data and guide the interpretation of complex results. DPIs using EMA data can help researchers to understand between-person variation in an outcome. Following study 3A, it was anticipated that not all participants in study 5 would be open to lifestyle advice at cancer screening. Therefore, the combination of EMA and DPIs were selected to explore the interplay of several constructs (e.g. affect) and differing levels of openness to physical activity advice over time.

The Conversation Time study was the first to use EMA and DPIs to understand receptivity to physical activity advice around the time of breast, bowel and cervical cancer screening. This qualitative study aimed to gain an in-depth understanding individual differences in screening participants’ receptivity to advice at cancer screening.

### 7.2 Methods

#### 7.2.1 Design

This qualitative study was embedded within a mixed-methods research project. The Conversation Time study used EMA to assess openness to a conversation about physical activity and cancer prevention around the time of cancer screening. The quantitative element of Conversation Time was a single-arm pilot study, which recruited 41 individuals with upcoming NHS cancer screening appointments. Participants downloaded a mobile application, which was used to collect rich quantitative data on the experience of cancer screening participation. Participants were sent a notification via the mobile app to answer questions five times per day for 11 days. The first set of questions were administered five days before the screening appointment, with the sixth day of measures falling on the day of the screening appointment and the eleventh day of measures falling five days after the screening appointment. In total, participants were sent 55 sets of questions. Measures were based on McBride’s Teachable Moment Heuristic (McBride et al., 2003). Items assessed affective response, perceived risk, positive outcome expectancies, self-concept, self-efficacy and openness to a conversation with a healthcare professional about physical activity and cancer prevention. In addition, participants provided contextual data, such

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22 [https://ethicadata.com/](https://ethicadata.com/)
as location and what they were doing when they received each set of measures. The full measures and administration schedule is presented in Appendix H.

7.2.2 Participants

The eligibility criteria for the wider Conversation Time study stipulated that participants must have an upcoming NHS cancer screening appointment: breast, bowel (FS) or cervical screening. The screening appointment needed to be approximately two weeks in the future, to allow for informed consent, app enrolment and five days of measures prior to the screening appointment. Participants were excluded from the research if they had received a previous diagnosis of the cancer that they were about to be screened for. Participants were required to understand spoken and written English. Participants were also required to have access to a smartphone with the capability to support the app for the duration of the study.

A range of recruitment methods were used to identify participants approaching an NHS cancer screening appointment. Firstly, adverts were posted on social media (Facebook), the Call for Participants recruitment website and posters were placed around University College London and the University of Leeds. A total of 399 participants completed an online eligibility questionnaire to determine study eligibility, of which 33 were eligible to participate and completed a baseline questionnaire (Appendix I). Fifteen participants consented, and 12 participated in the wider Conversation Time study. Recruitment took place between May 2017 and September 2018. Participants who were recruited through these methods were given a £20 Marks and Spencer voucher as an acknowledgement of the time taken to participate in this research.

Due to the limited success of these participant recruitment methods, a specialist participant recruitment agency (Saros Research Ltd.) was commissioned. Details of the study were emailed to 20,000 members of their participant database. The screening questionnaire was completed by 1,500 participants. The proportion of respondents eligible to participate was not recorded by Saros Research Ltd. However, 34 participants consented to the study and 29 successfully downloaded the study app. Participants recruited through Saros Research Ltd. were reimbursed £75 for taking part in the quantitative component of the study, and £25 for taking part in the qualitative component of the study. The total number of participants from both rounds of recruitment was 41.
7.2.3 Procedure for the current study

All participants who completed the Conversation Time study were invited to take part in a single follow-up interview. In order to be eligible to participate in the interview, participants must have attended their cancer screening appointment and be available for a thirty-minute interview over the telephone or in-person. Participants were informed that the purpose of the interview was to find out about their experience of cancer screening, and their experience of taking part in the ‘Conversation Time’ study. Participants were consented for the Conversation Time study and the qualitative study separately.

Thirty participants each participated in an interview, including four participants from the first round of recruitment and 26 participants from the second round of recruitment. A semi-structured interview topic guide was created (Appendix J), which was supplemented by each participant’s data from the quantitative component of the Conversation Time study. Participants were provided with a graphical summary of their data prior to the interview (Appendix K). The interviews ranged from 16.5 minutes to 67.7 minutes in length (average 31.5 minutes). Interviews were recorded and transcribed verbatim. Two interviews were conducted in person, one at University College London, one in a meeting room close to the participant’s home. All other interviews were conducted over the phone. Only the interviewer (Claire Stevens) and the participant were present during the interviews.

7.2.4 Ethical approval

Ethical approval was granted by University College London’s Research Ethics Committee (Project ID: 10165/001).

7.2.5 Analysis

The analysis of the data was partly deductive and partly inductive. The quantitative component of the Conversation Time project was based on the McBride et al. (2003) teachable moment heuristic. Therefore, the interviews and consequently the analyses were informed by this theoretical framework. However, an inductive approach to analysis was also taken, whereby data were also used to generate new ideas about cancer screening as a teachable moment for behavioural interventions.
The framework method of data management and analysis was used (Ritchie et al., 2013). Framework analysis allows data to be organised by both case and theme in a matrix. A series of steps are included in the data management aspect of framework analysis, starting with familiarisation of the data. For the present study, the framework process involved reading transcripts, listening to the recordings, and revisiting notes that were made during the interviews. The next stage of data management was the identification of initial codes and themes, which occurred concurrently with the familiarisation of the data. During this stage, notes were made of any initial recurring codes and themes. These codes and themes are used to develop an analytical framework in Microsoft Excel. Using the analytical framework (Appendix L), the data was charted. Charting involves summarising the data within the analytical framework. The initial framework included four charts, relating to participants’ experience of cancer screening (1), appraisals and management of risk (2), the impact of the cancer screening appointment (3), and receptivity to physical activity advice (4). At this stage, a second researcher (Dr Anna Roberts) reviewed a random 20% sample of transcripts providing additional summaries of the data for comparison. Transcript summaries were compared between researchers, and the initial analytic framework was refined through discussion.

Using the matrix of charted data, descriptive and explanatory analyses were conducted. Firstly, the initial themes identified in the charting stage were explored. There was variation in the way that individual themes were expressed by different participants. Therefore, the data were assessed for patterns, which were used to characterise and discriminate between participants. The explanatory analyses resulted in the development of a typology (four types) of receptiveness to physical activity advice at cancer screening. At this stage, a second random sample of 20% of transcripts were used to review the classification of participants into types by the second researcher (Dr Anna Roberts). As a limited number of people took part in the Conversation Time project, and all possible participants were offered to take part in an interview, data saturation was not assessed. The Consolidated criteria for reporting qualitative research (COREQ) checklist was

[23] https://www.google.com/search?q=random+number
7.3 Results

7.3.1 Sample characteristics

Thirty interviews were conducted with recent cervical (n=17), breast (n=10), and FS bowel (n=3) screening attendees. One in five participants were taking part in the cancer screening programme for the first time. Most of the participants were female (n=28) and of White ethnicity (n=27). The mean age of the sample was 44.5 years (range 27-69). Two-thirds of the sample were educated at degree level or above (66.7%). Characteristics for the whole sample, and broken down by participant type are presented in Table 7.1.

Table 7.1 Sample characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Whole sample (n=30)</th>
<th>Type 1 (n=6)</th>
<th>Type 2 (n=11)</th>
<th>Type 3 (n=8)</th>
<th>Type 4 (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>44.4 (11.5)</td>
<td>31.7 (2.2)</td>
<td>48.5 (12.9)</td>
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<td>43.6 (10.8)</td>
</tr>
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<td>Sex (Female)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td></td>
<td>93.3% (28)</td>
<td>100.0 (6)</td>
<td>81.8 (9)</td>
<td>100.0 (8)</td>
<td>100.0 (5)</td>
</tr>
<tr>
<td>Educated to degree level or above</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td></td>
<td>66.7% (20)</td>
<td>66.7 (4)</td>
<td>54.5 (6)</td>
<td>62.5 (5)</td>
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</tr>
<tr>
<td>Ethnicity (White)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
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<tr>
<td></td>
<td>90.0% (27)</td>
<td>83.3 (5)</td>
<td>91.8 (9)</td>
<td>100.0 (8)</td>
<td>100.0 (5)</td>
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<td>Screening programme</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical</td>
<td>56.7 (17)</td>
<td>100.0 (6)</td>
<td>45.5 (5)</td>
<td>50.0 (4)</td>
<td>40.0 (3)</td>
</tr>
<tr>
<td>Breast</td>
<td>33.3 (10)</td>
<td>-</td>
<td>36.4 (4)</td>
<td>37.5 (3)</td>
<td>60.0 (3)</td>
</tr>
<tr>
<td>Bowel</td>
<td>10.0 (3)</td>
<td>-</td>
<td>18.2 (2)</td>
<td>12.5 (1)</td>
<td>-</td>
</tr>
<tr>
<td>First time participating in screening programme</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td></td>
<td>20.0 (6)</td>
<td>16.7 (1)</td>
<td>27.3 (3)</td>
<td>12.5 (1)</td>
<td>20.0 (1)</td>
</tr>
</tbody>
</table>

1 Description of participant types in figure 7.1

7.3.2 Overview of results

Most participants were open to PA advice at some point during the screening process (at invitation, at the screening appointment, or alongside results). Receptivity was influenced by individuals’ affective response to cancer screening and how the information would be delivered. Four types of receptivity to advice were identified: (1) people for whom a negative screening
experience or negative anticipated screening experience (e.g. a strong negative affective response to the procedure or to thoughts about cancer risk) promoted receptivity; (2) people for whom a negative screening experience or anticipated screening experience inhibited receptivity; (3) people for whom screening was a positive or neutral experience and who were receptive to PA advice; (4) people whose receptivity to advice was contingent on how advice would be delivered, rather than on their screening experience (Figure 1).

Figure 7.1 Summary of types
Chapter 7. Interest in lifestyle advice cancer screening: data prompted interviews

7.3.3 Type 1. Negative cancer screening experience as a prompt for receptivity

Six participants were categorised within this type. A case study of a participant within this type is presented in Figure 7.2. Participants described a range of affective responses experienced across the screening process. Before the screening appointment, negative affective responses were reported, including worry, nervousness and vulnerability to cancer.

“I think I could push it to the back of my mind at first, but then as it [the screening appointment] was approaching and getting closer you start to worry a bit more about it then.” (Cervical screening, Female, #6)

For some participants, worries in the lead up to cancer screening were about the appointment itself, such as the possibility of experiencing pain or embarrassment.

“The nerves were, were about the appointment. But what I would... What I think the nerves were about was more [sigh] the having to go for the appointment, having to have the procedure done, as, as opposed to worrying about the outcome at that stage.” (Cervical screening, Female, #9)

For others, cancer screening prompted concerns about receiving a diagnosis of cancer. Cancer screening was described as a time where people would naturally be thinking about their cancer risk.

“I don't think people go for a cervical screening or any kind of screening without considering the fact that they might get it [cancer]. I think that's just human nature.” (Cervical screening, Female, #27)

Screening participants within this group described how their appointment prompted thoughts about developing cancer, over and above the thoughts they would experience in everyday life.

“So it’s making you think about it a little bit more than what you would in your day-to-day life and potentially an impact of that screening appointment could be that somebody said there is, there is, um, sort of an abnormality or something there that needs look, look, looking at. Um, so I think that probably increased it [ratings of cancer fear] slightly.” (Cervical screening, Female, #9)

Despite describing a range of negative experiences and affective responses prior to their screening appointment, participants within this type reported how negative responses dissipated quickly following their appointment, replaced by positive feelings such as relief.
"I think it was relief after it was done, because you know that’s it for a – a few years now… so I think it [nervousness and anxiety]– it does go – go away quite quickly, um but then you’re thinking about – you’re waiting for the results then.“ (Cervical screening, Female, #6)

When asked about their feelings about the delivery of physical activity advice at the screening appointment, participants within this type described how affective responses to cancer screening, such as nervousness, may promote receptivity.

"I think maybe at the time of the appointment is probably best, while you… while you’re still a bit nervous and they’ve got you. You know, ‘cause after it’s done like I’m on to the next thing.“ (Cervical screening, Female, #26)

The relevance of conversations about cancer prevention at the cancer screening appointment was recognised by participants. The salience of cancer prevention at the cancer screening appointment was used in support of the delivery of physical activity advice. The delivery of lifestyle advice during the cancer screening appointment was seen to capitalise on this salience, which some participants felt may diminish once they have left the screening appointment.

"I think the best time would be during your appointment um because you’re there anyway, it’s on the forefront of your mind and you – you know if you are probably thinking about it a bit more… I think like after the appointment, there’s sort of a feeling of right, that’s done with now, I can – can forget it. You know, after the results come, you can forget about it so I think while you’re already there and you’re thinking about it, I think that’d – for me that’d be the best time.“ (Cervical screening, Female, #6)

As well as being a time where cancer and cancer prevention is seen as salient, the cancer screening appointment was also seen as a convenient time for advice to be delivered. Participants felt that it was appropriate to deliver physical activity advice while they were already attending a medical appointment.

"I think, and just from a convenience point of view as well, you’re already there" (Cervical screening, Female, #6)
Participant 11 was a first-time cervical screening attender. She was highly anxious in the lead up to her screening appointment. The participant describes being scared of the unknown. Some of this participant’s concerns were about the screening appointment, such as whether it would be painful.

“There are so many unknowns of, one, how’s it gonna be, how’s the doctor gonna be, is it gonna be awkward, is it gonna hurt, how awkward will it be, will I have pain afterwards, will there be any repercussions afterwards? ... It’s, you’re worried, like, are you gonna be clean enough down there? Like, you’re going, you’re going in between work, and you’re just like, [gasp] like, you just have all these little worries that you didn’t even think of at the time.”

However, participating in cervical screening also prompted concerns about cancer. When asked to describe the graph which plotted her ratings of cancer worry for the duration of the study, participant 11 discussed how her worries about cancer increased in response to the screening appointment.

“So, it was, it was heavily, it was heavily worried, during the time I was, it, it, I was overly-worried. Whereas, it would have maybe been a 5 or a 4, the reason it was over, err, 7 and above, was because of, I was nervous about my appointment, and of the results”

Participant 11 describes how her anxiety about the screening appointment prompted her to search the internet for information about cervical screening.

“I was batshit cuckoo, and crazy, and nervous. That’s… That’s how I felt. I felt like I was searching the internet like I, I had a PhD… I just felt highly stressed with, err, of, being scared of the unknown.”

Participant 11 was pleased to discover that the cervical screening appointment was not as bad as she had been expecting and recalled she was relieved once the procedure was over.

“As soon as, as soon as the swab and everything, and I was like, ‘Is that it? Is that it? Is the…’ Like the, sort of, [sigh] like, it wasn’t, really, like, I, I, like, all the things I was feeling, like, worst case scenarios, it didn’t happen, and I was able to, like, breathe for the first time [laughing] in a long while.”

Despite being highly anxious about the screening appointment, participant 11 felt they would have been open to advice about cancer screening and physical activity during the screening appointment. They felt that the intimate nature of cervical screening meant that it was okay to discuss anything after the procedure.

“Yeah. You’ve already just exposed your, umm, [laughing] yeah…There’s no, there’s no conversation you can’t broach at that point.” (p14)
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7.3.4 Type 2. Negative cancer screening experience as an inhibitor of receptivity

There are several parallels between type one and type two. Within both types, participants report similar experiences of participating in cancer screening. However, the eleven participants within type two were not in favour of the screening appointment itself being used to discuss physical activity and cancer prevention. A case study of a participant in type two is presented in Figure 7.3.

In common with type one, participants within type two described a range of negative affective responses and experiences in relation to their cancer screening appointments.

“On the appointment, if it... I was, as I said before, I was really, erm, stressed and, erm, I was only thinking about how ashamed I would be.” (Cervical screening, Female, #8).

Participants within this type had anticipatory concerns about the screening appointment itself, with fears about the possibility of experiencing pain or embarrassment, or worries about whether the healthcare professional conducting the screening would be nice. For some women within this type, it was their first time participating in cancer screening, which added to anticipatory their concerns.

“Quite anxious really. Erm, I just had no idea what to expect. I mean you've got your leaflets and people telling you erm... But I just wasn't sure. I expected it to be really really painful so I was really anxious” (Breast screening, Female, #13).

In addition to anticipated fears about the screening appointment, some participants had negative experiences during the screening appointment itself. For example, one woman who participated in FS screening experienced an enema failure, which resulted in increased feelings of stress.

“When I got there, when I had my screening, umm, I, when I had the, the, the scan, when I went to, they took me through there, got the tube halfway up, and then said, ‘Oh, actually, we'll need to give you an extra enema.’ ... And then I kind of had to abort, go out, and they gave me an enema, and I had to go and sit outside, ... That, that's kind of the worst bit. And then, to sort of say, ‘Oh, no, never mind, oh, we have to do that again.’ That probably just made it a little bit more stressful for me, than it needed to have been.” (Bowel screening, Female, #16)

Participants within this group also described how participating in cancer screening prompted them to think about cancer more than they would usually.

“I probably don’t actually think about it terribly often, but I think, just the process of going through this pricks your ears up a bit; like if you, if you buy a pink car, you
then notice more pink cars on the road. I think it’s that sort of syndrome. Because I was going to have this done, it was making me think about it, Google a little bit more, hear about other peoples’ good stories and bad stories, about people who have had screenings” (Bowel screening, Female, #16)

As a result, some participants felt particularly at risk of developing cancer around the time of their cancer screening appointment.

“I think the screening appointment makes everybody think of cancer, even if you, even if you’ve had it [screening] before I think it’s something you think, oh right, yes, definitely, um, um, I’m going to get cancer or I have cancer. It’s, err, it... The screening is good but I think you get yourself into a state where you think I’ve got cancer.” (Breast screening, Female, #17)

Participants within this type felt strongly that the screening appointment was not an appropriate time to instigate a conversation about physical activity and cancer prevention. Some participants used very emotive language to describe their feelings about the cancer screening appointment being used to deliver cancer prevention advice, such as taboo, crazy, and rude.

“I would probably be not a very happy person... It’s, yeah, it’s just, it’s very rude, to be honest. You’re nervous enough as it is and then to have someone tell you what you should have been doing, when you weren’t doing... And it’s, it’s just crazy.” (Cervical screening, Female, #14)

One participant described how they would interpret conversations about cancer prevention at screening as a cause for concern. This participant felt that a conversation instigated at screening would suggest that the screening practitioner had seen something untoward during the appointment.

“’Cause people will go, ‘Jesus, well, why are you saying that to me? Like, do you think I’ve got something? Do you...’ And, and, and then, if you’ve done the test, and then you sit down with someone and they’re like, ‘Okay, so, we’ll come back to you with the results, but let’s talk about how we can reduce cancer.’ You’re literally going to go, well, what have you seen? What have, what, what have you found? Why are you talking to me about, about that?’” (Cervical screening, Female, #30)

In addition to concerns about the appropriateness of delivering lifestyle advice at cancer screening, many participants felt experiences of cancer screening meant that they would not have been able to process any advice that was given at that time. A feeling of information overload at the time of cancer screening was a common occurrence among this group.
“Probably not on the day you have the screening, because I think you’ve got a bit more on your mind than having, you know. And you might not just, you might not remember, take in, what you’ve been told.” (Cervical screening, Female, #10)

For other participants, their concerns about their cancer risk at the time of screening would prevent them from taking cancer prevention advice on board.

“I was too focussed – on being convinced I was, I was going to get, or I had, cancer. Um, and that I wouldn’t have been, um, open to listening to anybody about that, on that particular day.” (Breast screening, Female, #17)

While this group were against the provision of physical activity advice during the cancer screening appointment, they were open to receiving cancer prevention advice at alternative time points across the screening continuum. Most commonly, this group were open to advice after they had received a negative screening result.

“On the actual day it is taboo, as far as I’m concerned, but once once you get your results, you know, a lot of people would get the results, and if it's positive [negative result], they think, oh right, that's it then, put the letter away, and off I go for another three years. Other people will dwell on it and think, oh, well, that's good, what have I been doing that helps me to avoid it? Erm, and then I was thinking if if you were revising the results, that might be something you could build in, I don’t know, to a letter or a follow-up phone call. And just say, ‘well, you've had all your results blah blah blah; would you be receptive to having a discussion erm, you know, because what we want is for this to continue on for the next three years, you know.’” (Breast screening, Female, #15)
Participant 30 describes feelings of nervousness about their upcoming cervical screening appointment, despite having previous experience of attending cervical screening.

“I was n… nervous, umm, because, I mean, it’s, it’s, it’s not horrendous, but it’s not the most pleasant experience. I mean, doctors and hospitals and whatnot are, are, y’know, I think, bring out sort of negative emotions in people anyway. Umm, and obviously, you are gonna be nervous, just about the p… the procedure and things like that, but, yeah…”

When asked how they felt about the provision of lifestyle advice during the cancer screening appointment, participant 30 felt conversations about cancer prevention could initiate thoughts about cancer and cancer risk.

“a lot of people probably just come in and think, ‘Oh, I’m just doing this ‘cause I’ve got my letter through and I’m not really thinking about it.’ You’re kind of automatically putting that illness into their mind.”

This participant also discussed how conversations about cancer prevention may be interpreted negatively by screening participants, suggesting that people may be concerned that healthcare professionals have seen something concerning during the screening appointment.

“Cause people will go, ‘Jesus, well, why are you saying that to me? Like, do you think I’ve got something? Do you…’ And, and, and then, if you’ve done the test, and then you sit down with someone and they’re like, ‘Okay, so, we’ll come back to you with the results, but let’s talk about how we can reduce cancer.’ You’re literally going to go, well, what have you seen? What have, what, what have you found? Why are you talking to me about, about that?”

While this participant did not advocate the use of the screening appointment for discussions about cancer prevention, they did feel that it would be appropriate to have these discussions once a person has received an all-clear screening result.

“So, I think that it’s best to do it afterwards. Y’know, once, either, someone’s got their results… you sort of say, y’know, good news, but, y’know, obviously, there are ways that you can improve, this, this, this and this. So, that’s, that’s, that’d be my thoughts.”
7.3.5 **Type 3. Positive experience promotes receptivity**

Eight participants described a neutral or positive experience of cancer screening. These participants were open to the delivery of lifestyle advice at the cancer screening appointment. A case study of a participant within this type is reported in Figure 7.4.

“I wasn't concerned, I wasn't worried, erm I just erm as ever erm felt it was something erm something good to do.” (Breast screening, Female, #24).

Most participants within this type had previous experience of cancer screening and were at ease with the screening process.

“I've been having them for a long time. Erm, I'm 50 years old, so I've been having them for half my life and they don't bother me.” (Cervical screening, Female, #2)

Some participants reported they did not experience some of the negative physical and affective responses commonly described by participants within types one and two.

“I don’t know whether I’m unusual in not finding those things traumatic at all, the actual physical, erm, smear testing and what-have-you” (Cervical screening, Female, #2)

However, this group were not necessarily exempt from negative feelings and experiences at cancer screening, such as discomfort. Despite some participants reporting negative experiences, the overriding feeling about screening participation was that it was a positive and necessary action.

“I don’t have any concerns or anything like that um in regard to screening. You know, it’s – it’s uncomfortable for a period of time, but it’s a necessity. It needs to be done and um I’m more – I’m more concerned about making sure it gets done and gets done on time than – than um – than anything else.” (Cervical screening, Female, #19).

Participants within this type were open to conversations about physical activity and cancer prevention. However, participants did not necessarily feel that there was something specific about the screening appointment that made them open to a conversation at that time.

“I would have been happy to be approached. Erm, but for me there wouldn't have been erm, if you understand, erm any sort of connection between the two. Like I I I wouldn't feel the need for, I wouldn't be thinking, well, this is a good idea erm to do this at this time, any more than I would be thinking, well, it's not a good idea. You know, that's just my general general feeling about it.” (Breast screening, Female, #24).
Within this type, openness tended to be due to the convenience of having a conversation at that time.

“I think definitely, ’cause I mean that’s, that’s when you’re geared towards it. … especially with busy lives it’s like, oh right, Thursday is the day I get the screening, um, I’m thinking about it a little bit now but I’m really busy with work, whatnot, um, but at Thursday, at that particular time, I’m gonna focus just on this. So they’ll, they’ll be in the zone so to speak.” (Cervical screening, Female, #21).

Some people within this type recognised that not everybody would be open to this conversation as they are.

“I think some people unlike myself might be feeling quite worried and concerned about the test, and erm they might feel it it might make them actually feel quite angry to be erm approached then with erm, you know, with questions of this nature when they’re already feeling very anxious and overwhelmed and… I think it would depend on the individual” (Breast screening, Female, #24).

However, two participants felt that there could possibly be positive consequences of having conversations about physical activity and cancer prevention during the cancer screening appointment. They felt that if delivered in the right way, advice could reduce people’s negative experiences of the cancer screening appointment.

“Having a – a conversation like that, so long as it’s done in the right way, might help ease the tension in the room because I know… I mean, not personally because I’ve had too many of them, but I know that lots of people, lots of women um are very sort of nervous and apprehensive about having smears. Then maybe if they knew that it wasn’t just kind of going in and having the procedure, maybe by going in and having that conversation first, it might um lessen the atmosphere in the room.” (Cervical screening, Female, #19).
Participant 12 describes how they were not nervous about attending their cervical screening appointment. They likened cancer screening to attending an eye test or visiting the dentist.

“I wouldn’t say I was nervous. I was just, it was just one of those things I had to do. It was kind of like, ‘Oh, I have to do this today, so, I’ll go…’ It’s like another chore, another thing to add to the list of things to do… I kind of see it, see it as, umm, like any other test, like an eye test, or a dentist’s appointment. It’s just those things that you have to have done regularly.”

Following her cervical screening appointment, participant 12 felt positively about the experience.

“I think on the day I went for my appointment, I probably felt quite positive, that I’d done something positive, err, y’know, to prevent myself, not to prevent myself getting cancer, but having it being diagnosed early, so that I would, y’know, err, that I’d get treatment.”

Participant 12 described how she felt that in participating in cancer screening she was doing something proactive. Consequently, participating in cervical screening reduced her feelings of worry and risk about cervical cancer.

“I think it made me, err, not worry about it. I think it meant I’m doing something positive, err, to in… decrease my risk of, of developing some… Y’know, I am, I’m doing something pro-active. So, I think it, it probably has the opposite effect. It probably made me think, ‘Oh, actually, I’m doing…’ If I didn’t go for the screening, I’d probably think, it might be in the back of my mind, err, that there might be something wrong, and I haven’t, err, y’know, been for a screening.”

Participant 12 was open to receiving advice about physical activity and cancer prevention at this time. They felt that people would be more open to receiving advice at the cancer screening appointment, compared with other visits to their medical practice, as it is a time where they are not feeling unwell.

“I think it’s a very good time. I think, I think it’s a perfect time. I think it’s, I think, after you’ve had the screening … I think that’s a good time, err, ‘cause you’re there already. You’re not there because you’re ill, or anything. You’re not there because you’re, y’know, you’re not feeling under the weather, so you’re probably a bit more open to, a… kind of, having a conversation.”
7.3.6 Type 4. Conditionally receptive

Unlike participants in types one, two and three, the openness of participants in type four to conversations about physical activity and cancer prevention at screening was not defined by their experience of the cancer screening appointment. Rather, this group’s receptivity was contingent on how advice would be delivered. A case study of this type is presented in Figure 7.5. Five participants were categorised as conditionally receptive.

“I think it depends how it’s done, and how they say it, and, and whether or not you’re doing the right thing or not. I think, nobody likes to be, sort of, told off, do they?” (Breast screening, Female, #20)

Concerns were raised about potential negative consequences of information that was delivered in a way that is perceived by the participant as nagging or judgemental. One participant stated that they would be deterred from attending cancer screening if they felt they would be told off about their current lifestyle.

“I think it probably isn’t the right time, because I think it’s more likely that it would put people off. Umm, I think it might put me off from going, if I knew, if somebody was gonna say... really have a go at me about something.” (Breast screening, Female, #20)

Participants within this type discussed the importance of the characteristics of the healthcare professional delivering lifestyle advice.

“I think it would depend on the person that was doing it. Because I’ve had three people that have struck me as quite different styles and different people.” (Breast screening, Female, #3).

Specifically, people wanted information from a credible source, such as someone with medical expertise who would be able to answer questions about the topic.

“In an ideal world if, you know, budget was no problem, whatever, a nurse would be great, you know somebody who you can actually ask, erm, er, a medical question and they can answer it. So I’m not expecting them to, erm, but, you know, erm, to answer a question about my medical history, but, you know, erm, like I could ask, ‘yeah, but what about that? What about that?’ and they would actually master the subject.” (Cervical screening, Female, #1).

People also wanted to receive information that was more advanced than simply being told about the link between physical activity and cancer. People wanted to hear about the latest research on the topic and what specifically they should be doing to reduce their cancer risk.
“I wouldn't be adverse to it, as long as... as long as it's, erm, just not, 'Oh you know if you increase your, er, your exercise regimen, you will decrease your cancer risk.' Yeah. No, that's kind of... I think... I think most people know about that now. ... I would want to be able to dig it and dig into it and ask more questions then, but I would be very open. Yeah, very open to it.” (Cervical screening, Female, #1).

People within this type also discussed how it was important to tailor advice to the individual receiving it. This was particularly important for people with disabilities that impact their ability to participate freely in physical activity.

“It would be a little bit offensive if someone said, ‘Blah, blah, blah, blah, exercise, blah, blah, blah, blah,’ and I’m sitting there in a wheelchair, erm, you know, I... I think you’ve got to choose your audience quite carefully; it's quite delicate isn't it?” (Breast screening, Female, #25)
Participant four was a recent cervical screening attendee. This participant described how a physical disability and a mental health condition impact their day to day activities, including attending appointments such as cancer screening and taking part in physical activity.

“Like, it was a, like, my doctors is really close so it was literally as, it was as, it was as stress-free as it could be, bearing in mind that I like have this disability and like doing anything is quite stressful. So it was a stress but like, because I’ve got to like make sure that there is like someone there to try and wake me up”

When asked for their opinions on the provision of physical activity advice at cancer screening, participant four discussed their previous experience of vague, patronising and generic advice.

“Erm, I find like quite a lot of these things can be given quite vague and like sometimes quite patronising terms, if I’m being completely honest. And it’s not necessarily tailored to the individual so like if you just have generic health advice being given out and it’s not necessarily tailored to the individual.”

The tailoring of advice about physical activity was particularly important for this participant in relation to their disability.

“I’m just like, “Oh, here we go.” I’m like, “Yes, yes. I know this. Yes, thank you. Yes, exercise good. Yes, I am aware of this. Yes, I do have a disability actually. I’m trying to get social services to help with this, it’s actually a bit more complicated than just oh, wouldn’t it be nice if I did more physical activity.” So I think if it’s like tailored to the individual then that’s good”

The participant felt that if conversations about physical activity at cancer screening were not tailored to their personal circumstances, they could cause experience distress.

“But like, if it’s a nurse that I think I’d never seen her before. You know, she’s not going to know, she’s not going to have time to look at my medical records, she’s not going to know me. Whereas like my GP knows all my health background and stuff, and she wouldn’t just suddenly say, “Oh, you know, wouldn’t it be great if you did physical activity?” Because she would know I would probably burst in tears and be like, “I know, I miss netball so much.”

Despite a dislike for generic advice, this participant felt that a generic leaflet would be preferable to information delivered by someone who cannot provide specialist tailored advice.

“I guess maybe if it was like, if it was like a leaflet or something you could look up yourself afterwards, that would probably… I’d probably be more open to that rather than somebody who potentially doesn’t know anything about me and my health conditions, or probably might not be really that much of a specialist in cancer themselves giving it, yeah.”
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7.4 Discussion

This study built upon Chapters 5 and 6, which demonstrated that the provision of lifestyle advice at cancer screening is acceptable for the majority of people intending to participate in cancer screening. Four types of screening participant were identified, each with unique views on whether NHS cancer screening programmes were a suitable opportunity to deliver physical activity advice for cancer prevention. Types one and two describe how seemingly similar experiences of cancer screening can result in contrasting effects on receptivity to physical activity advice at cancer screening. These types focus on negative physical (e.g. pain), affective (e.g. nervousness) and risk-related experiences of breast, bowel and cervical cancer screening. For some participants, negative experiences were in anticipation of their screening appointment, rather than their experiences of the appointment itself. Negative experiences were found to either promote (type one) or inhibit (type two) receptivity. Some participants found cancer screening to be an overall neutral or positive experience (type three). This group was generally open to receiving physical activity advice at the time of the screening appointment. A final group of participants (type four) reported that their openness to physical activity advice at cancer screening was dependent on how the advice would be delivered.

Some of the findings of this study are in common with previous research. One study found that women attending breast screening clinics were open to lifestyle advice and interventions in this setting (Conway et al., 2016). However, it was also reported that some participants felt the provision of lifestyle advice could raise anxiety among women. This was also a concern for participants in type two within the present study, who reported negative physical and affective experiences of cancer screening. Within this group, concerns were also raised about deterring people from participating in cancer screening when approaching conversations about physical activity and cancer prevention. Chapters 5 and 6 report that a minority of people may be put off attending breast, bowel, cervical and lung cancer screening if they knew they would be given lifestyle advice. Taken together with the findings presented in this chapter, it is essential to consider how lifestyle advice may be received by this group. It is important to note that not all participants who described negative experiences of cancer screening were concerned about the
provision of lifestyle advice causing distress or impacting screening uptake (e.g. type one). Furthermore, some participants suggested that the integration of lifestyle advice into cancer screening could put some people at ease (type three).

The measures included in the Conversation Time study were based on the McBride Teachable Moment Heuristic (McBride et al., 2003). The model proposes that factors such as an affective response or change in risk perception prompt behaviour change following a cueing event. There has been limited research evaluating the model within the context of cancer screening. The findings of this study provide valuable insights into some of the key components of the model in a sample of recent screening participants. The Teachable Moment Heuristic proposes that affective responses to an event precede changes in a behaviour. A number of affective responses were described by the study participants, including nervousness, anxiousness and shame. This study was not concerned with a change in a behaviour, rather openness to a conversation about physical activity and cancer prevention. An important finding to emerge in this study is that the role of the affective response is likely to be more complicated than the Teachable Moment Heuristic suggests. Rather than a simple model where screening prompts an affective response, and an affective response prompts openness to physical activity advice, this study found that negative affective responses can both promote and inhibit openness, as evidenced by types one and two. Furthermore, some people do not experience a strong affective response but are still open to advice in the screening setting.

A similar picture emerges for participants’ judgements of risk. The Teachable Moment Heuristic proposes that increases in perceived risk promote behaviour change. However, types one and two demonstrate how increases in risk perceptions can lead to contrasting levels of openness to a conversation about physical activity in the screening context. Participants in both types described the salience of cancer and cancer risk at the time of screening. However, types one and two differ in the way that increased risk perceptions influence receptivity. In type one, the salience of cancer risk was used in support of a conversation about physical activity as it is a time where people would be considering their risk. In contrast, in type two, increased feelings of risk
associated with screening participation meant that people felt that they would not be able to process any information given at that time.

In a study set within a lung cancer screening setting, physicians highlighted the potential for screening participants to be too overwhelmed during screening to take in any information about lifestyle modification (Kathuria et al., 2018). This was certainly a concern for participants in type two, many of whom felt that they would experience ‘information overload’ if the screening appointment was used to discuss physical activity. Participants within type two were not against the provision of lifestyle advice. However, this group felt the screening appointment was not the most appropriate timing for the delivery of advice. In Chapters 5 and 6, breast, bowel, cervical and lung screening intenders reported their preferences for the timing of lifestyle advice around the cancer screening appointment. Around thirty per cent of people who were open to receiving lifestyle advice at breast, bowel or cervical cancer screening wanted it at a time other than the cancer screening appointment (Chapter 5). This suggests that one way to maximise the acceptability of lifestyle advice in the context of cancer screening is to give participants the opportunity to decide when they would like to receive the advice.

In addition to preferences about the timing of advice in relation to the screening appointment, participants had views about the content and delivery. Participants in type four were classified as conditionally receptive to advice. While this does not mean that they did not discuss their experiences of participating in cancer screening, the predominant factor associated with their openness was how the advice would be delivered. Similarly, participants in types one, two and three were categorised based on their experiences of screening; however, this did not mean that they did not express views on how physical activity advice should be delivered in the screening context. Participants wanted advice that was non-judgemental. Unsurprisingly, this has been reported in other qualitative studies exploring the acceptability of lifestyle advice in screening contexts (Chambers et al., 2019). Participants in type four warned of putting people off attending if advice was delivered in a way that people felt they were being judged for their behaviour.

Participants also described the importance of information being provided by a credible source. This relates to previous research in breast clinics, in which patients highlighted the need for
consistent, evidence-based advice on alcohol consumption (Sinclair et al., 2019). Participants in type four wanted the opportunity to be able to ask questions about the relationship between physical activity and cancer. They wanted advice that went beyond simply being told about the link between physical activity and cancer, and felt that it was important to be given advice about the kinds of activity that would be most beneficial. A common theme when discussing the provision of physical activity advice was the importance of tailoring the advice to the individual. Participants felt that advice should take into account their current levels of activity. Tailoring was particularly important for participants who had physical disabilities. Participants recognised that healthcare professionals might need specialist knowledge in order to provide appropriate advice on physical activity, and stressed the importance of approaching conversations about physical activity with sensitivity.

7.4.1 Reflexive account

It is essential to consider the ways in which my position as a researcher could have influenced this project. Firstly, my background as a researcher exploring cancer screening as a teachable moment may influence the way that the interviews were conducted and the data were analysed. While I made every attempt to approach this research with neutrality, it was impossible to separate myself from the knowledge that I had gained throughout this doctorate, prior to the interviews. Before the interviews took place, I had read literature within this area and conducted my own research which influenced my view about the acceptability of cancer prevention advice within screening settings. It is possible that this prior knowledge might have influenced the questions and probes that I asked during the interviews and the way that I interpreted participants responses.

Another important consideration is about how research participants may have viewed my positionality. It is possible that participants believed that I endorse the delivery of lifestyle advice alongside cancer screening, and therefore felt that their own responses needed to be in line with this view. If this is the case, it could result in overly positive opinions about this topic. This relates to the power dynamic between researcher and participant. The dynamic between researcher and participant is often hierarchical, where the researcher is viewed by the participant as the authority
on the subject matter. During the interview, I attempted to build rapport, put participants at ease, and reassure them of the value of their experiences. However, it is not possible to know whether participants felt truly able to share their views.

7.4.2 Directions for future research

The results of this study provide valuable insights into how the participant experience of cancer screening influences receptivity to cancer prevention advice at this time. In this study and in studies 3 and 4, the delivery of lifestyle advice alongside cancer screening appears to be acceptable. However, a key question remains outstanding; is there something about the cancer screening appointment that increases receptivity to lifestyle advice, or would people be equally receptive to advice at other times? Furthermore, it is not known whether advice provided in the context of cancer screening is more effective than advice delivered in other settings. Future research should compare the efficacy of advice in screening settings with other contexts.

7.4.3 Strengths

There are a number of strengths to this research. This study was the first to explore views about the provision of lifestyle advice across multiple NHS cancer screening settings. The study used a novel methodology, EMA, to collect rich quantitative data as a basis for in-depth DPIs. The methods used in this study have a number of advantages over traditional qualitative interviews. The use of DPIs can aid the memory of participants, which can overcome some of the issues with asking participants to recall events. In addition, DPIs give research participants the opportunity to become embedded in the research process. A number of participants remarked on how much they enjoyed being able to view and reflect upon the data they had provided. This kind of participant involvement is also beneficial to the researcher. DPIs allow researchers and participants to give meaning to complex quantitative data, which would otherwise require an element of subjective interpretation on the part of the researcher. Another strength of this research, is that recent cancer screening participants were recruited, overcoming some of the limitations of the hypothetical scenarios presented in Chapters 5 and 6.
7.4.4 Limitations

Several limitations of this research need to be acknowledged. Firstly, the methods used to identify screening participants may have resulted in a sample who hold more positive views about participating in cancer screening. None of the sample were totally against cancer screening being used as an opportunity to deliver physical activity advice at any time point across the screening continuum. This adds further evidence to suggest the sample may not be representative, as all previous quantitative studies have identified participants who are not willing to receive lifestyle advice (Chapters 5, 6 and Fisher et al. 2007). Only 10% of the sample were FS screening participants, and just two of the FS participants were male. This is due to the limited number of people invited to participate in the FS screening programme annually, relative to the breast and cervical screening programmes. The views of breast, cervical and FS screening participants were pooled. It was, therefore, not possible to determine whether there were differences in openness to physical activity advice between screening programmes.

Discussions about cancer screening as a teachable moment for behaviour change were guided by the Teachable Moment Heuristic (McBride et al., 2003). This lead to a partly deductive approach to data collection and analysis. Numerous models of health behaviour and health behaviour change exist, and DPIs based on other models may have prompted different discussions about openness to receiving physical activity advice alongside cancer screening. Furthermore, not all measures included in the quantitative component of the study generated conversations to the same extent. For example, the measure of self-concept (‘describe how you would rate your current overall health’) prompted little discussion about the experience of cancer screening. It is not known whether cancer screening does not influence self-concept or whether the measure used is not valid for the purpose of this research.

Finally, a single topic of conversation was selected as a focus for this study: physical activity. This topic was selected as physical inactivity is highly prevalent in the English population, and this topic is, therefore, likely to be relevant to a large number of screening attendees. However, advice about other important cancer risk factors, such as smoking, alcohol consumption, body weight or diet may be received differently by screening participants.
7.4.5 Conclusions

The findings of this research highlight the diverse and individual screening experience. For three of the types described, screening experience was found to influence receptivity to physical activity advice in the screening context. For the fourth type, openness to physical activity advice was driven predominantly by how the advice would be delivered. While the provision of PA advice at cancer screening is generally acceptable, the views of NHS screening participants do not support a ‘one-size-fits-all’ approach to delivery. Interventions developed in screening settings must be sensitive to the diverse experiences of screening participants, and their preferences for the timing, content and mode of delivery.
Chapter 8. General Discussion

Millions of people participate in NHS cancer screening programmes annually. There has been considerable interest in whether cancer screening provides a teachable moment for behaviour change. However, varying conceptualisations of the teachable moment have led to two distinct streams of research on this topic: cancer screening as a prompt for spontaneous changes to health behaviour, and cancer screening as an opportunity to provide cancer prevention advice. This thesis sought to advance our understanding of the teachable moment by addressing some of the critical research gaps within this area. This final chapter will bring together the five studies and consider the implications of this research on theory, practice, and future research, as well as the limitations of the work presented in this thesis.

8.1 Summary of main findings

This section will consider each of the three aims of this thesis in turn. Studies that were designed to address each of the three aims will be summarised and compared with existing literature. The limitations and implications of the research will be briefly discussed here, and discussed in detail in sections 8.2, 8.3, 8.4 and 8.5.

8.1.1 Aim 1. To explore whether participation in cancer screening programmes prompts spontaneous changes to health behaviours.

This aim was addressed by a systematic review (Chapter 3) and a prospective cohort study of English adults (Chapter 4). The review sought to synthesise and evaluate literature investigating whether spontaneous behaviour change occurs following breast, bowel, cervical and lung screening. Twenty-nine studies were identified within bowel and lung screening settings. The most common outcome was smoking cessation, which was assessed in all studies bar one. Crucially, no studies were identified exploring behaviour change in the context of breast and cervical screening programmes. While a number of studies reported positive changes to health behaviours following screening participation, most of these studies used single-arm observational research designs. Of the limited studies which compared screening participants with control or comparator groups, few found evidence of spontaneous behaviour change at cancer screening. The review concluded that bowel and lung screening participation
are unlikely to prompt spontaneous changes to health behaviour, with the caveat that many outcomes and screening modalities are under-researched.

Despite including 29 studies with a broad range of outcomes, screening modalities, and research designs, the results of this review were broadly similar to others previously conducted on this topic (Deutekom et al., 2011; Slatore et al., 2014; van der Aalst, van Klaveren, et al., 2010). Furthermore, directions for future research that were identified in previous reviews had not been addressed in the intervening time. For example, a review conducted more than 15 years ago highlighted the need for prospective studies exploring behaviour change in breast and cervical cancer screening settings (Bankhead et al., 2003). There is yet to be any research exploring spontaneous behaviour change within these settings.

Initial literature searches conducted as part of the systematic review at the beginning of this PhD identified another important research gap. No research had been conducted looking at the teachable moment in existing NHS screening programmes. Thus, study 2 was developed. The ELSA provided an opportunity to compare health behaviour and behaviour change in a sample of NHS screening participants and non-participants, without the barriers of recruiting directly from the screening programme. For most behavioural outcomes, this study did not find evidence of spontaneous change prompted by FOBT participation. However, an interesting relationship between FOBT participation and participation in VPA emerged. Over the course of two years, the proportion of FOBT participants taking part in VPA increased. This finding is particularly remarkable when compared to the comparator group. The proportion of FOBT non-participants taking part in VPA reduced over the two-year period. This result was tentatively interpreted as evidence that screening participation might prompt changes to physical activity. However, it is essential that this finding is replicated in similar samples.

Study 2 was the first to use population cohort data to examine cancer screening as a teachable moment for health behaviour change. The methodology employed in study 2 has also been used to understand other teachable moments, such as a cancer diagnosis or diagnosis of type 2 diabetes (Hackett et al., 2018; Williams et al., 2013). However, due to the novel approach taken to understand the teachable moment at screening, it is difficult to make direct
comparisons between this research and other observational research. The data provides a potentially less biased account of behaviour change following cancer screening, compared with single-arm observational studies (Miles et al., 2003; Sriphanlop et al., 2018). This is because it is possible to compare participants who chose to participate in screening following an NHS invitation to a natural comparator group of non-participants. However, as highlighted in the systematic review (Chapter 3) the approach used in study 2 may be more open to bias than RCTs measuring behaviour change among screened and unscreened groups. Generally, for physical activity, observational research has demonstrated changes to physical activity following bowel screening (Miles et al., 2003; Sriphanlop et al., 2018). Conversely, data from RCTs does not support the suggestion that bowel cancer screening is a teachable moment for spontaneous changes to physical activity (Berstad et al., 2015; Helander et al., 2017; Larsen et al., 2007).

Neither study 1 nor study 2 provide convincing support for cancer screening as a prompt for health behaviour change. However, there are number of important caveats to this conclusion. Firstly, studies 1 and 2 used frequentist approaches to determine whether cancer screening participation prompts spontaneous behaviour change. Studies 1 and 2 reported a number of null results. Using frequentist approaches, null results are interpreted as evidence of no relation between variables. Bayesian analysis may aid the interpretation of null results, by analysing data in relation to prior knowledge about a relationship between variables (van de Schoot & Depaoli, 2014). Secondly, a number of screening modalities and outcomes remain unexplored, particularly within existing cancer screening programmes. Finally, there are a number of methodological considerations that limit the conclusions that can be drawn from the existing literature. A discussion of how future research may better answer this question is presented in section 8.4.

**8.1.2 Aim 2. To gauge interest in lifestyle advice at cancer screening**

In the absence of evidence for cancer screening prompting spontaneous changes to health behaviours, study 1 and study 2 concluded future research should investigate the appetite for
lifestyle advice in NHS cancer screening settings. Three studies within this thesis contributed to this aim (study 3, study 4, study 5).

Study 3 (Chapter 5) sought to estimate levels of willingness to receive information about cancer risk factors within NHS breast, bowel and cervical screening programmes. In study 3A, around 80% of people intending to participate in breast, bowel and cervical cancer screening would be willing to receive lifestyle advice in conjunction. This is similar to previous estimates of willingness to receive advice alongside breast cancer screening (Fisher et al., 2007). Generally, these results are also in line with qualitative studies which report that most people are open to receiving lifestyle advice alongside cancer screening (e.g. Sinclair et al., 2019).

Study 4 (Chapter 6) attempted to replicate the findings of study 3 within a sample of people intending to participate in lung cancer screening. This was the first study to explore the acceptability of lifestyle advice within this setting. Around two-thirds (64%) of the sample were willing to receive lifestyle advice, if they were invited to participate in lung screening. Interestingly, this increased to 83.1% in a scenario where participants received results which required further investigations. This finding suggests that around 20% of people may only feel that lifestyle advice is relevant if their screening results are concerning. Importantly, this finding highlights that this group of people may be subject to a health certificate effect, whereby negative screening results endorse existing cancer risk behaviours (Stewart-Brown & Farmer, 1997; Tymstra & Bieleman, 1987). In study 3A, similar proportions of participants were willing to receive lifestyle advice in breast and bowel screening scenarios of screening in general, and screening followed by a result which requires further investigations. However, in the case of cervical screening, a greater proportion of participants (+6%) were willing to receive advice in the scenario where further investigations were required. These results suggest that more work is needed to understand how screening participants interpret different types of screening result, in relation to cancer-preventive behaviours.

One concern raised by both study 3A and study 4 was the potential for the provision of lifestyle advice to have an adverse effect on screening uptake. A minority of people intending to participate in cervical (4.9%), breast (7.0), bowel (8.8%) and lung cancer screening (13.9%)
reported that the provision of lifestyle advice would deter future participation. Almost three times the number of people would be put off attending lung screening, compared with cervical screening. This suggests that lung screening may be a particularly contentious setting in which to provide cancer prevention advice. One reason for this might be that smokers, who make up a large proportion of those eligible for lung screening, often feel stigmatised for smoking and report concerns that they will be nagged about quitting smoking (Quaife, Marlow, McEwen, Janes, & Wardle, 2016). Another explanation for the differences observed between lung screening and other modalities is that lung screening is not widely offered outside of trial settings in the UK. Therefore, potential lung screening participants may not know what to expect from this screening programme. Previous qualitative research has found that smokers see lung cancer as an uncontrollable disease, and feel that an invitation to lung screening could induce fear (Quaife et al., 2017). This group may be anticipating a negative screening experience more than potential participants of established screening programmes. Concerns about the provision of lifestyle advice deterring screening participation were also raised by recent screening participants in study 5. The findings of study 5 suggest that the provision of lifestyle advice may deter screening attendance for some, particularly for people who have a negative screening experience.

While a small proportion of participants in studies 3A and 4 indicated they would be put off screening if lifestyle advice was provided, in all screening scenarios a greater proportion of participants indicated lifestyle advice would increase their willingness to participate. It is important to note that all samples were of screening intenders, so results may not reflect the invited screening population. However, as not all screening intenders take up their invitation to participate, the provision of lifestyle advice may help to close the intention-behaviour gap for some groups. It is important that future research examines the positive and negative effects of lifestyle advice on screening acceptability, uptake and cost effectiveness (Villanti, Jiang, Abrams, & Pyenson, 2013).

Study 3A and four highlight that interventions at screening are not likely to be acceptable to all and that some screening intenders may be put off from attending if they knew that they would
receive cancer prevention advice. Therefore, it is important to attempt to identify factors associated with interest in advice in screening settings. Findings from study 3A suggest that interventions delivered within the context of bowel screening must work to appeal to men and that interventions at cervical screening, if not all settings, must be accessible to populations with lower educational attainment to avoid exacerbating health inequalities. The high levels of interest in lifestyle advice at cervical and lung screening among the small number of non-White participants is encouraging. As health outcomes are often poorer among ethnic minority groups, health promotion interventions may benefit from being culturally adapted to ensure that the demand for interventions within ethnic minority groups is met (Liu et al., 2012).

Both study 3B and four found that participants not meeting recommendations for cancer risk behaviours were more likely to be willing to receive advice about most topics of advice. This finding suggests that people most in need of advice are willing to receive it at screening. Millions of people participate in cancer screening programmes annually. While the population of screening attendees may be healthier than the general population (Shapiro et al., 2001), a large number of screening participants stand to benefit from interventions delivered alongside screening (NHS Digital, 2018b). Another determinant of interest in advice was cancer risk factor awareness (study 3A, study 4). Participants who recognised a greater number of cancer risk factors had greater odds of interest in advice. However, it is not known whether increasing cancer risk factor awareness would increase willingness to receive lifestyle advice at cancer screening.

Study 5 built on the findings of studies 3 and 4 by conducting interviews with recent NHS screening participants about the provision of physical activity advice alongside screening. In line with results from study 3A and 4, not all participants were willing to receive advice at the cancer screening appointment. However, study 5 identified potentially important factors relating to willingness to receive advice which were not assessed by the questionnaires used in studies 3 and 4. A key finding of study 5 was that the experience of the cancer screening appointment was a major contributing factor to openness to lifestyle advice at cervical, breast and bowel cancer screening. Therefore, in addition to demographic and behavioural factors
highlighted in studies 3 and 4, contextual factors relating to the screening appointment are likely to influence willingness to receive lifestyle advice at cancer screening. The findings of study 5 discussed in detail in section 8.1.3.

Studies 3, 4 and 5 all provide valuable information about participants’ preferences for advice delivered alongside cancer screening. In study 3A, the majority of people willing to receive advice at screening wanted the information to be provided at the screening appointment itself. The second most common response was for information to be provided with the screening results. Upon reflection of the results of study 3A, the decision was made to include an additional response option in study 4, to allow participants to express a preference for information delivered prior to the screening appointment. This decision was made as a limited amount of information about behavioural risk factors for cancer is currently included in leaflets provided alongside screening invitations (NHS, 2016, 2018, 2019a, 2019b; Public Health England, 2018). If participants had a preference for advice delivered before the screening appointment, screening leaflets could be used to disseminate additional information and advice about cancer risk reduction. In study 4, around one in five participants reported a preference for advice delivered prior to the screening appointment. The most commonly preferred timing of advice was at the screening appointment (37%), closely followed by with the screening results (31%). These findings have implications for the delivery of advice in practice, discussed further in section 8.5.

Studies 3B and 4 investigated participants’ preferences for the types of information provided at cervical, breast, bowel and lung cancer screening. As highlighted in the introduction to this thesis and in study 1, research to date has often taken a narrow view of cancer screening as a teachable moment, by considering single cancer risk behaviours within single screening programmes. For example, smoking has been the only target for behaviour change interventions within both lung (Iaccarino et al., 2019) and cervical screening settings (e.g. Hall et al., 2007). A unique finding of study 4 is that lung screening participants may be open to advice about a range of cancer preventive behaviours, including diet, weight and physical
activity. Similarly, in study 3B, around two-thirds of screening intenders were willing to receive advice about these topics.

Findings from study 5 highlight the importance of the way that information is delivered alongside cancer screening programmes. A group of screening participants who were 'conditionally receptive' to advice at screening was identified. A number of key factors relating to the delivery of advice were raised by participants. This group wanted information that was tailored to their abilities and circumstances and wanted that information to come from a credible source. In addition, these participants stressed the importance of information being delivered in a way that was non-judgemental. Participants warned that if the delivery of advice was unacceptable, people might be put off from attending screening. These findings are reflective of previous qualitative research conducted with breast screening participants (Chambers et al., 2019; Sinclair et al., 2019).

Together, the findings from studies 3, 4 and 5 strengthen the rationale for delivering lifestyle advice alongside cancer screening. While not all screening participants will be open to receiving cancer prevention advice, these studies provide valuable insights into how to deliver advice in a way that is acceptable to screening attendees whilst being aware of potentially adverse outcomes on screening uptake.

8.1.3 Aim 3. To understand individual differences in screening participants’ receptivity to advice at cancer screening

The third aim of this thesis was addressed by study 5. This was the first study to relate screening experience to receptivity to physical activity advice. The study was informed by the McBride et al. (2003) teachable moment heuristic. Thirty recent cervical, breast and bowel screening participants were recruited. The key finding of this study is that the experience of cancer screening is highly individual. Subsequently, there are differences in how screening experience impacts openness to cancer prevention advice. Openness to cancer prevention advice was characterised by four types of participant — three types related to screening experience. The first two types demonstrate how similar experiences of screening can have different outcomes on openness to cancer prevention advice. For participants in type one, a
negative screening experience or negative anticipated screening experience (e.g. a strong negative affective response to the procedure or to thoughts about cancer risk) promoted receptivity. Conversely, in type two, participants who reported similar negative screening experiences were not open to cancer prevention advice at screening. The third group of people had a positive or neutral experience and were receptive to cancer prevention advice. The fourth type of participant was conditionally receptive to advice. Their views are summarised in section 8.1.2.

A range of positive and negative screening experiences were described by participants in study 5. Participants who had a negative screening experience had concerns about the screening appointment itself (e.g. pain and embarrassment), and about the possibility of receiving a diagnosis of cancer (e.g. risk appraisals). Negative screening experiences were both anticipatory (e.g. fear of the unknown), or based on the actual screening appointment (e.g. difficulties with the procedure). These experiences either motivated or inhibited openness to a conversation about cancer prevention at the screening appointment. Not all participants had negative screening experiences. Some participants felt that cancer screening was a positive and necessary action that they were taking. This group was open to a conversation about cancer prevention at cancer screening.

The findings of this study are novel and can help to explain why lifestyle advice is not acceptable for all, in a way that was not possible in studies 3 and 4. A consideration of how the findings of this study relate to the model and other models of behaviour change is considered in section 8.3. Furthermore, the findings of this study have implications for future research (8.4) and for the implementation of behavioural interventions at screening (8.5).

8.2 Limitations

The limitations of individual studies are discussed in their respective chapters. However, there a number of general limitations of this thesis.
8.2.1 Sample selection

A limitation across all studies within this thesis is that it was not possible to recruit participants directly from cancer screening programmes. Therefore, a range of alternative participant selection methods were employed. Studies 3 and 4 were reliant on data from screening intenders. Population representative surveys of English adults was used to identify people potentially eligible to participate in breast, bowel, cervical and lung cancer screening. This contrasts to previous research exploring the acceptability of lifestyle advice at breast screening, where participants were recruited directly from clinics following screening (Fisher et al., 2007). Levels of acceptability were broadly similar between this study and study 3. However, estimations of the impact of lifestyle advice on screening uptake were much higher in study 3, compared with previous research.

There are several issues with using data from screening intenders. Firstly, intention to participate in cancer screening does not always translate into actual screening participation (Sheeran, 2002). This means that a proportion of people who were asked about the acceptability of lifestyle advice at cancer screening may never attend, which may limit the comparability of this sample with actual screening participants. Another issue with using screening intenders in research is the need for hypothetical screening scenarios. Within studies 3 and 4, participants were unlikely to have had experience of lung or bowel cancer screening, but a large proportion of the sample had previous experience of breast and cervical cancer screening. Therefore, there may be differences in the way that the samples responded to these scenarios, based on their previous experiences of cancer screening programmes. A final issue with the use of screening intenders for study 4 was that participant selection was selected based on age and smoking status, rather than using a validated risk prediction model to identify participants who might be eligible for lung cancer screening. This means that, in contrast to the criteria for breast, bowel and cervical cancer screening, the sample may not exactly reflect the population invited to participate in a lung screening programme.

Another issue that is relevant to all studies is the representativeness of the samples. In the systematic review (study 1) a number of studies reported rates of smoking cessation are
greater than would be expected in the general population. For example, one study reported a biochemically verified 11.9% reduction in smoking among baseline smokers in their screened group, an 11.8% reduction in their control group, but estimated the quit rate of the Danish general population to be 4% (Ashraf et al., 2009). One explanation for this is that the sample selected may differ from the general population. In studies 3 and 4, weights were applied to the samples to attempt to ensure that the data were representative of the general population. However, sub-samples of the data-sets were used in analyses, which were not individually weighted. It is, therefore, possible that the sub-samples were not truly representative of the population that would participate in cancer screening. Data from study 2 were taken from the ELSA, which is said to be representative of English adults. However, even in samples that are recruited to be demographically representative, there is a chance that these samples reflect a more health-conscious sub-sample of the population. In study 2, this suggestion is supported by the fact that screening participation was higher in the ELSA sample than would be expected in the general population (von Wagner et al., 2011). There is also evidence of this in study three, where rates of overweight in the sample were almost 20% lower than estimates from the general population (NHS Digital, 2018b).

8.2.2 Measurement of health behaviour

A key limitation of studies 2, 3 and 4 is the use of self-report measures of health behaviour. Self-report measures of health behaviour may not most accurately reflect health behaviour due to issues of recall and reporting bias. Objective measures of behaviours such as diet are particularly difficult. While it is possible to objectively measure behaviours such as smoking and physical activity, it is often not practicable. Studies 3 and 4 were survey-based; therefore it was not possible to administer objective measures at the time of data collection. In order to collect objective measures of health behaviour, a different research design would have been necessary. In addition, the application of objective measures of behaviour, such as accelerometry for physical activity are often burdensome for participants. Study 2 was an analysis of secondary data. Therefore, it was not possible to select the measures used as part of the data collection.
A further limitation that arose from study 2 is the timeliness of measurement. It was not possible to determine the time between the screening appointment, baseline and follow-up measures; however, assessments were approximately two years apart. This makes it difficult to conclude whether health behaviour change may occur in the short term following cancer screening. It is important to carefully consider the timing of follow-up measurements, depending whether the outcome of interest is long-term or short-term behaviour change.

### 8.2.3 Social desirability, interviewer effects and measurement reactivity

Studies 2, 3, 4 and 5 are open to social desirability bias. Social desirability is a bias where research participants tend to respond in the way they feel they are expected to respond, or in a way in which they feel would be viewed favourably (Lavrakas, 2008). Sensitive research topics, such as health-related research, may be particularly open to this bias. This a common phenomenon is observed across a range of research designs, including survey research (studies 2, 3 and 4) and qualitative research (study 5). In studies 2, 3, and 4, participant’s responses to items about their health behaviours, including screening participation, may have been affected by this bias. In studies 3, 4 and 5, participants may have responded favourably to questions about the implementation of lifestyle advice at cancer screening, if they viewed that as the most socially desirable response. Furthermore, in study 5, there may have been interviewer effects. This occurs when there is direct contact between research participants and researchers. The participants may have regarded my position as a researcher in favour of delivering lifestyle advice at screening. Therefore, some participants may have felt the need to align their views with their perceptions of my views. This may also have occurred in studies 2, 3 and 4, where data were collected using home-based interviews. Although most data collection was self-complete, and participants may have understood that the interviewer did not represent the researcher, it is possible that responses may have been influenced by the presence of a researcher.

Another challenge of conducting research exploring behaviour change in the context of cancer screening is the impact of measurement reactivity (French, Sutton, Id, & French, 2010). This is the idea that measurement can affect cognition, emotion, and behaviour. This is a particular
issue when attempting to measure behaviour change, and therefore impacts studies 1 and 2. Measurement reactivity can impact both subjective and objective measurements. Objective self-report measures are subject to a question-behaviour effect, which is relevant to all studies within this thesis (Miles, Rodrigues, Sniehotta, & French, 2020). One area where measurement reactivity is relatively well understood is in the measurement of physical activity. Even measures which are considered objective, such as accelerometry, are subject to this bias (Motl, McAuley & Dlugonski, 2012). When designing research measuring behaviour change, it is important to consider how measurement reactivity may impact outcomes. Where possible, measurement reactivity should be reduced. For example, measurement reactivity for accelerometry reduces over time, therefore, disregarding the first days of data collection can help mitigate this bias. Furthermore, measuring health behaviour in the context of cancer screening programmes may not only prompt changes to health behaviour but may influence screening uptake (Helander, Hakama, & Malila, 2014). In a study conducted within a Finnish colorectal screening trial, a random sample of participants was sent a lifestyle questionnaire prior to an invitation to screening. Fewer participants who received the lifestyle questionnaire attended screening (56.6%), compared with participants who did not receive the questionnaire (60.2%).

### 8.2.4 Comparison with other settings

One further limitation of this research presented in this thesis is the lack of comparison between cancer screening and other contexts. In studies 3 and 4, participants were only asked about their willingness to receive advice at breast, bowel, cervical and lung screening. Interest in receiving advice was high across all screening programmes. However, it is not clear whether willingness to receive advice would be just as high in other settings. To better understand cancer screening as a teachable moment, future research must explore the patient experience of receiving advice at screening, and consider what it is about screening that makes participants willing to receive information in this setting.
8.3 Theoretical implications

This section will consider the findings of this thesis in relation to theories of the teachable moment. As outlined in the introduction to this thesis, the term ‘teachable moment’ is used inconsistently, and consequently the teachable moment is poorly conceptualised. One example of this comes from study 1 (Chapter 3). The systematic review search failed to identify almost 30% of the papers included in the review. This suggests that refinement in terminology used to describe teachable moments and behaviour change may also be required. Efforts have been made within intervention research to create a taxonomy of behaviour change techniques to increase transparency, reproducibility and discoverability of behaviour change literature (Michie et al., 2013). Similar principles could be applied to research exploring the impact of exposures (e.g. cancer screening) rather than interventions on health behaviour.

The predominant theory of the teachable moment was proposed by McBride and colleagues in 2003. The theory (detailed in section 1.5) proposes that a number of key changes need to happen in order for a teachable moment to occur (Figure 1.1). This theory characterises a teachable moment as a prompt for spontaneous behaviour change. However, according to Lawson and Flocke (2009), the term teachable moment is only used to refer to spontaneous behaviour change around 20% of the time. Studies 1 and 2 do not provide support for cancer screening as a teachable moment for spontaneous health behaviour change to multiple cancer risk behaviours. However, a modest increase in VPA was observed among FOBT participants in study 2.

McBride et al’s theory of spontaneous teachable moments proposes that changes to perceived risk, positive outcome expectancies, affective responses, self-concept and social role that occur at screening result in behaviour change (McBride et al., 2003). Neither the systematic review presented in Chapter 3 (study 1) nor study 2 (Chapter 4) explored determinants of behaviour change at cancer screening. While some of the studies identified in the systematic review did attempt to explore predictors of behaviour change at screening, including risk perceptions (Park et al., 2013), and motivation to quit smoking (Clark et al., 2016; Ostroff et al., 2001), none of the identified studies explicitly and fully tested theoretical frameworks such
as the Teachable Moment Heuristic (McBride et al., 2003). Understanding the determinants of behaviour change may contribute to the development of theories and models of the teachable moment.

While the Teachable Moment Heuristic (McBride et al., 2003) was originally developed to explain spontaneous behaviour change following a health event, the findings of studies 3, 4 and 5 suggest that this model could be extended to explain openness to behavioural interventions delivered at screening. In addition, the model could be used to understand other factors related to intervention development, such as uptake and engagement, or to understand the effectiveness of interventions. One aspect of the Teachable Moment Heuristic observed in studies 3, 4, and 5 related to participants’ understanding and appraisals of risk. Study 3 did not find an association between comparative risk perceptions and interest in lifestyle advice at screening. However, in study 5, feelings of cancer risk and vulnerability were found to both promote and inhibit openness to cancer prevention advice at screening. This finding could be used to build upon the existing model. The existing model describes a single, positive effect of increased risk perceptions on the creation of the teachable moment. However, findings from study 5 suggest that this relationship may be more complex, with increases in risk perceptions having both a positive and negative impact on openness to cancer prevention interventions. This complex relationship between risk perceptions and interest in lifestyle advice may explain why an effect was not observed in the survey research (study 3).

Studies 3A and 3B and 4 did not set out to extensively test the teachable moment constructs. However, an interesting finding related to the Teachable Moment Heuristic emerged. Study 3B and study 4 found that cancer risk factor awareness was positively associated with interest in cancer prevention advice. The data were cross-sectional, so cannot be used to determine whether increasing cancer risk factor awareness has a positive impact on the creation of a teachable moment. However, a meta-analysis of studies assessing the impact of heightening risk appraisals on intentions and behaviour suggests that interventions have the potential to positively influence intentions and behaviour (Sheeran, Harris, & Epton, 2014). These findings warrant further investigation in a cancer screening setting.
Affective responses to health events are also implicated in the creation of the teachable moment by McBride et al. (2003). For some participants in study 5, an affective response to screening participation was found to be important in promoting the teachable moment. However, this was not the case for all participants. As with risk perceptions, similar affective experiences of cancer screening had polarised effects on openness to cancer prevention advice for different groups. Once again, this finding suggests that an extension to the Teachable Moment Heuristic, to encompass both positive and negative impacts of the constructs, may improve our understanding of the teachable moment at screening. An illustration of how the McBride et al. (2003) model might be adapted to reflect this is shown in figure 8.1. Note that only the affective response and perceived risk constructs are included in this example.

One important finding of study 5 was that not all participants experienced an affective or risk related response to cancer screening. Yet, these participants were still open to receiving advice at the screening appointment. This leads to a crucial theoretical consideration: is cancer screening a teachable moment for behaviour change, or simply an acceptable moment for behaviour change interventions? Studies 3, 4 and 5 indicate that the integration of cancer prevention advice into screening settings is broadly acceptable. However, to date, no research has explored whether the receipt of cancer prevention advice is more acceptable in screening settings compared to other settings such as the workplace (Cahill & Lancaster, 2014).
Furthermore, it is unknown whether behaviour change interventions are more effective if instigated in cancer screening settings. Answering these questions would help to clarify the conceptualisation of the teachable moment.

It is also important to consider how behaviour change at cancer screening fits in with other theories and frameworks of behaviour change. If cancer screening is simply an acceptable moment for behavioural interventions, Lawson and Flocke’s (2009) conceptualisation of the teachable moment may be appropriate. This theory states that teachable moments can be created through interactions between patients and healthcare professionals. This concept is in line with policy to make every contact count (Public Health England, 2016b). The theory expands on the Health Belief Model (Rosenstock, 1974) taking into account both patient and clinician’s perceived threat and cues to action within the wider healthcare system. Indeed, the Health Belief Model informed the development of the Teachable Moment Heuristic. Therefore, these two theories of the teachable moment are not entirely distinct. For example, both discuss cues to action, people’s value judgements of an event, and the perceived threat of a behaviour.

“Future research would benefit from a more thorough exploration of the potential mechanisms involved in creating the teachable moment at screening. A number of psychological mechanisms of change were proposed by McBride et al., (2003). The McBride Teachable Moment heuristic remains under tested in the domain of cancer screening. One example is of risk perceptions, which are often measured using a single item (study 3). However, according to Ferrer and colleagues (2016), risk perceptions are multidimensional. Other aspects of the Teachable Moment Heuristic, such as self-concept, remain poorly defined for many behaviours. While, there are measures for smoker self-concept (Shadel & Mermelstein, 1996), similar measures do not currently exist across the range of cancer risk behaviours such as diet. Consequently, some aspects of the Teachable Moment Heuristic have not yet been explored. Therefore, comprehensive assessment of all components of the McBride Teachable Moment Heuristic may improve our understanding of behaviour change at cancer screening.

As the Teachable Moment Heuristic was not designed with cancer screening in mind, it is also important to look to other theories for potential mechanisms of action. Future research should
consider components of Lawson and Flocke's extension of the Health Belief Model (2009). Constructs not included in the Teachable Moment Heuristic include perceived severity of the disease, perceived barriers to behaviour change, and importantly individual characteristics such as sociodemographic factors. A criticism of the McBride Teachable Moment Heuristic is that it does not include sociodemographic determinants of behaviour, such as age, gender, ethnicity and socioeconomic position. It is important that theories of the teachable moment look beyond psychological factors in order to understand behaviour change.

The theoretical conceptualisation of the Teachable Moment at cancer screening is still in its infancy. Therefore, there is great scope to generate theory of behaviour change within this context. One approach would be to conduct a review of psychosocial factors associated with cancer preventive behaviours and factors associated with cancer screening. Research could explore associations between the pool of factors and receptivity to lifestyle advice in order to generate a working model of the teachable moment at cancer screening. In light of the results of study 5, it is crucial that future theories of the teachable moment consider the differential effects of certain factors (e.g. affect) on receptivity. For example, affective responses may drive receptivity for some screening participants and inhibit receptivity for others. Finally, when we are able to map the mechanisms involved in the teachable moment at screening, it is also important to consider whether the mechanisms are amenable to change. For example, if self-efficacy is positively associated with receptivity to advice, does increasing self-efficacy increase receptivity to advice?

8.4 Implications for future research

The work presented in this thesis highlights a number of directions for future research. Firstly, in relation to determining whether cancer screening prompts spontaneous changes to health behaviours, study 1 and study 2 highlighted a number of critical research gaps. Firstly, there has been no research exploring breast and cervical screening as a prompt for spontaneous behaviour change. Research to date has also largely explored smoking at lung screening, neglecting other important cancer risk factors. The majority of research exploring behaviour change following screening has been conducted in trial settings. This means that findings may
not be generalisable to participants attending existing NHS screening programmes (Hestbech et al., 2011; Koo et al., 2017). There are a number of challenges to conducting research within existing screening programmes. Firstly, research would require approval and coordination of a number of key stakeholders. For example, to measure behaviour change at cervical screening, it would require coordination between the ‘call and recall’ systems to identify people approaching eligibility for a screen, as well as screening providers to contact women with invitations to participate in research. Despite these barriers, it is important to attempt to understand the impact of NHS screening programmes on a range of cancer-related health behaviours.

Secondly, an important consideration when exploring spontaneous behaviour change at cancer screening is whether analyses inadvertently mask positive and negative changes to health behaviour. Studies 1 and 2 explored overall changes in health behaviours across the whole sample. It is possible that cancer screening prompts positive or negative behaviour change in some attendees and no behaviour change in other attendees. If rates of positive and negative behaviour change are balanced, it may appear that participation in cancer screening does not influence health behaviour at all. A more nuanced approach to analysing health behaviour change at cancer screening might further our understanding of the teachable moment, and may be more appropriate given the findings of study 5 which suggest there are individual differences in peoples responses to screening. It is possible to make this distinction in some existing studies, but not others. For example, studies which include baseline former-smokers in lung screening settings reported both smoking cessation and relapse, allowing both positive and negative behaviour change to occur within their samples (Ashraf et al., 2014). However, in studies that included only smokers at baseline, it is only possible to observe positive behaviour change or no behaviour change. While there is little evidence for an overall effect of lung or bowel cancer screening on health behaviour, it is important to understand who might be more likely to display negative or positive changes in behaviour following screening, so that adequate behavioural support can be provided.
Key to furthering our understanding of the teachable moment at screening is the timeliness of measurements. There is suggestive evidence that spontaneous behaviour change following cancer screening may manifest only in the short term (Berstad et al., 2015; Larsen et al., 2007). It is therefore important to select measures that are sensitive to change and can be delivered at the right timings to detect changes. One methodology that might be suited to this is EMA (described in Chapter 7; Shiffman et al., 2008). For example, it could be beneficial to conduct objective measures of outcomes such as PA in close proximity to the screening appointment, which can be collected alongside measures related to models of the teachable moment. If studies show that behaviour change occurs in the short term, but is not sustained in the long term, it is important to explore how to capitalise on changes made soon after the screening appointment.

In order for interventions to be recommended in practice, it is important to understand the feasibility and efficacy of interventions delivered alongside cancer screening. Studies 3 and 4 indicate the majority of breast, bowel and cervical screening intenders are willing to receive lifestyle advice alongside cancer screening programmes. However, it is unknown whether willingness to receive advice would remain high in real-life screening settings, and whether receipt of advice would result in behaviour change. Trials conducted within bowel and breast screening settings suggest around half of attendees (49% and 43% respectively) are interested in participating in interventions focused on topics such as physical activity, weight loss, and alcohol consumption (Anderson, Craigie, et al., 2014; Anderson, Macleod, et al., 2014). Retention of participants enrolled in these interventions appears to be high (93% and 81% respectively), suggesting it is feasible to deliver interventions within screening settings. However, the effectiveness of interventions targeting multiple cancer risk factors alongside cancer screening programmes is yet to be confirmed (Senore et al., 2012).

A vital area for future research is understanding how to balance screening participants’ preferences for interventions delivered at screening with the efficacy of different modes of delivery. One example of this is screening participants’ differing preferences for timing of lifestyle advice. In study 6, there was no clear preference for the timing of advice at lung cancer
screening, with different people preferring advice before, during or after the appointment. The research presented in this thesis does not explore what features (such as timing) may make interventions at screening most effective. It is possible that the most effective delivery modes may be at odds with patient preferences. Therefore, it is important that future research attempts to better understand the trade-off between acceptability and efficacy. For example, a factorial trial could be used to test a range of intervention components in the context of cancer screening (e.g. timing, content, delivery mode; Montgomery, Peters, & Little, 2003). This research design may be more efficient than conducting RCTs using parallel groups to test different intervention components. As well as the impact of intervention components on health behaviour, it would also be possible to measure the acceptability of intervention components and monitor the impact of interventions on screening uptake.

Furthermore, it is important to understand whether changes to behaviour can influence cancer outcomes. The positive impact of smoking cessation on lung cancer risk reduction is well documented (Peto et al., 2000). However, the link between health behaviour change and cancer risk reduction for other risk factors is less conclusive. In order to determine the impact of behavioural interventions on cancer risk, RCTs with large sample sizes, long follow-up periods and appropriate endpoints are needed (Harvie, Howell, & Evans, 2015). Consequently, few studies have explored this effect. Two prospective cohort studies have observed that postmenopausal weight loss was associated with breast cancer risk reduction of up to 64% (Byers & Sedjo, 2011; Eliassen, Colditz, Rosner, Willett, & Hankinson, 2006; Harvie et al., 2005). One large RCT of almost 50,000 postmenopausal women explored the effect of a dietary fat reduction intervention (Prentice et al., 2006). There was no significant reduction in invasive breast cancer in the intervention arm. Alternative endpoints, such as hormonal changes and mammographic breast density, have been explored to understand the potential impact of behavioural interventions on breast cancer risk (Choudhury, Bernstein, Hodis, Stanczyk, & Mack, 2011; Friedenreich et al., 2010; Masala et al., 2018). But, further evidence is needed to demonstrate the effect of interventions targeting modifiable breast cancer risk factors on breast cancer risk.
8.5 Implications for practice

Studies 1 and 2 explored whether cancer screening is a prompt for spontaneous behaviour change. These studies found little evidence of positive or negative change following screening participation. Therefore, spontaneous health behaviour change should not be considered a substantial benefit or harm of cancer screening. However, in line with MECC policy (Public Health England, 2016b), cancer screening should be considered as an opportunity to support behavioural cancer risk reduction.

There are several important factors to consider for the implementation of behavioural interventions into NHS cancer screening programmes. Studies 3, 4 and 5 suggest that a personalised approach to intervention delivery is needed. This fits with the NHS Long Term Plan to provide a personalised approach to healthcare (NHS, 2019c). For example, these studies suggest that the timing of interventions is crucial, but preferences may differ greatly between participants. In study 3A and study 4, many participants had a preference for the delivery of lifestyle advice at the cancer screening appointment itself. However, this is complicated by the fact that some participants in study 5 felt strongly that it was not appropriate to deliver lifestyle advice at the screening appointment. A personalised approach to the content of interventions is also likely to be required, based on participants’ current behavioural risk factors and their preferences (studies 3 and 4).

One important consideration for practice is how different screening results are communicated in relation to screening participants’ health behaviours. In studies 3A and 4 greater proportion of lung and cervical screening intenders would be willing to receive lifestyle advice if their results required further investigations. This finding suggests that some screening participants may only see lifestyle advice as relevant if they receive an abnormal screening result, signalling a potential Health Certificate Effect of screening (Stewart-Brown & Farmer, 1997; Tymstra & Bieleman, 1987). It is important that screening participants are encouraged to make positive changes to health behaviours, regardless of their screening results. Although it is possible that an abnormal screening result might be a more effective teachable moment than a normal result (Slatore et al., 2014).
Chapter 8. General discussion

A key concern about the implementation of lifestyle advice at screening is the potential adverse impact of interventions on screening uptake. This concern was highlighted in study 3A, study 4 and study 5. If lifestyle advice were to be integrated into screening programmes, it would be important to monitor screening uptake closely or find ways to mitigate this risk. The benefits of providing lifestyle advice would need to be carefully weighed up against the risks of providing advice. The available evidence, which is predominantly from screening trials, does not currently allow for this kind of analysis within the NHS cancer screening programmes.

Interventions delivered at cancer screening have the potential to reach large numbers of people annually. However, one concern about delivering lifestyle advice at cancer screening is that screening non-attenders may not be reached if interventions are delivered at the screening appointment itself (Anderson et al., 2013). This is a problem because people from more deprived areas, non-White populations, and people with poorer health behaviours may be less likely to attend cancer screening (McGregor et al., 2015; Moser et al., 2009; Shapiro et al., 2001). One study found that in 2012, 75.3% of women from the highest quintile of area-level deprivation participated in cervical screening, compared with 80.2% of women from the least deprived quintile (Douglas et al., 2016). This means that within the context of cervical screening, three-quarters of people from the most deprived areas could be offered information and advice about cancer prevention. Furthermore, if information was provided at the point of screening invitation, the reach of the teachable moment could be even wider.

Another outstanding question is whether it is most effective to target single or multiple health behaviours at cancer screening. In breast and bowel cancer screening settings, interventions commonly target multiple health behaviours including diet and physical activity (Anderson et al., 2013). However, other settings, such as cervical and lung cancer screening have generally focused on a single cancer risk factor; smoking (Iaccarino et al., 2019). Literature on the utility of multiple behaviour change interventions is complex. One large meta-analysis of 69 RCTs found that multiple behaviour change interventions can be effective at improving energy balance behaviours, including diet and physical activity (Meader et al., 2017). The review also found that multiple behaviour change interventions can successfully reduce smoking.
However, studies that targeted smoking alongside other health behaviours, found that reductions in smoking were negatively associated with changes to those other health behaviours. Therefore, the authors suggest that a sequential approach, rather than a simultaneous approach, to multiple behaviour change interventions may be most appropriate. This information may have different consequences for different screening programmes, as populations attending different screening programmes differ in the health behaviour profiles. For example, a high proportion of lung screening attendees will be current smokers, therefore smoking cessation will be a high priority for interventions delivered in this setting (Joseph et al., 2018). In contrast, interventions delivered at breast or bowel cancer screening may view energy balance behaviours as higher priority intervention targets. Therefore, future research should investigate whether single behaviour or multiple behaviour (simultaneous or sequential) interventions are most effective in different screening settings.

Finally, it is important to consider the rapidly changing landscape of cancer screening in England. Within the timeline of this PhD, there have been several important changes to NHS cancer screening programmes in England. Cervical screening has changed from cytological screening to primary HPV testing, FOBT has been replaced by FIT, and FS has been more widely implemented. It is important that research responds rapidly to changes in the healthcare system, to fully understand both the impact of screening on health behaviour and the acceptability of lifestyle advice delivered alongside screening programmes. Future changes to cancer screening programmes may provide both opportunities and challenges to the teachable moment at cancer screening. For example, trials of new screening programmes could be used to test interventions delivered at screening or to measure the impact of health behaviour on cancer screening without the barriers of working within existing screening programmes. However, changes to how screening programmes operate could remove opportunities to make every contact count. An example of this is cervical self-sampling, which was recently suggested as a way to improve screening uptake (Richards, 2019). If this change was to be widely implemented, the number of teachable moment interactions between health care professionals and screening participants would be reduced.
8.6 Priority areas for future research

Taking into account the above implications for theory, future research and practice, I suggest two priority areas for research on cancer screening as a teachable moment for risk reduction behaviour:

1. To understand how to balance intervention efficacy with screening participant preferences and screening uptake
2. To develop theory on the mechanisms of behaviour change at cancer screening

8.7 Concluding remarks

This thesis sought to advance our understanding of cancer screening as a teachable moment for risk reduction behaviours. One conceptualisation of the teachable moment is that of prompt for spontaneous health behaviour change. This thesis has demonstrated that cancer screening participation alone is unlikely to prompt spontaneous changes to health behaviours, but found that most screening participants would welcome lifestyle advice. Future research must work to better understand what influences receptivity to advice at screening, for whom, and whether this is amenable to change. Together, the findings presented in this thesis point towards the need for personalised interventions in the screening setting, which are built around the diverse experiences and needs of screening participants.
References


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Appendix A. Systematic review search strategy

Systematic review search strategy

Bibliographic databases: MEDLINE (OVID), PsycINFO (OVID), EMBASE and Web of Science

Years considered: No date restrictions will be imposed.

Language: The search will be restricted to English language publications.

Publication status: In the event that any conference abstracts or research protocols are identified, authors will be contacted and asked to provide further details of the studies.

<table>
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<th>STAGE</th>
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<tr>
<td>1. General cancer screening terms</td>
<td>Cancer and (screening or &quot;early detection&quot; or &quot;mass screening&quot;)</td>
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<tr>
<td>2. Specific cancer-related terms (all four cancer types)</td>
<td>(adenocarcinoma and (bowel or breast or lung or cervi*)) or &quot;bowel cancer&quot; or &quot;colon* polyp*&quot; or &quot;colorectal neoplasm*&quot; or &quot;colorectal cancer&quot; or &quot;colonic neoplasm*&quot; or &quot;rect* neoplasm*&quot; or &quot;rect* carcinoma&quot; or &quot;breast neoplasm*&quot; or &quot;breast cancer&quot; or &quot;lung neoplasm*&quot; or &quot;lung cancer&quot; or &quot;uterine cervical neoplasm*&quot; or &quot;cervix cancer&quot; or &quot;cervix intraepithelial neoplasia&quot; or &quot;cervix adenocarcinoma&quot; or &quot;cervix squamous carcinoma&quot; or &quot;adenosquamous carcinoma&quot; or CIN</td>
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<td>3. Screening AND specific cancer types</td>
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<td>4. Specific cancer screening terms</td>
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<td>7. Teachable moment</td>
<td>&quot;health education&quot; or &quot;health promotion&quot; or &quot;teachable moment&quot; or opportunity or receptivity or &quot;health information&quot; or &quot;health behavio<em>r&quot; or &quot;risk reduc</em> behavio<em>r&quot; or &quot;behavio</em>ral risk factor*&quot; or (spontaneous AND &quot;behavio*r change&quot;)</td>
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<td>10. Deduplicate on EndNote</td>
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<td>11. Remove non English language articles (EndNote)</td>
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Appendix B. Publication: Lifestyle changes associated with participation in colorectal cancer screening: Prospective data from the English Longitudinal Study of Ageing

Original Article

Lifestyle changes associated with participation in colorectal cancer screening: Prospective data from the English Longitudinal Study of Ageing

Claire Stevens¹, Samuel G Smith¹,², Charlotte Yrinten¹, Jo Waller¹ and Rebecca J Beeken¹,²

Abstract

Objectives: Population-based cancer screening has been described as a teachable moment for behaviour change. This research examined the effect of faecal occult blood testing (FOBT) participation on smoking, alcohol consumption, fruit and vegetable consumption and physical activity.

Setting: Data were from screening-naïve men within the English Longitudinal Study of Ageing, receiving their first FOBT invitation (n = 774). Four waves of data were included in analyses (waves 4, 2008/2009 – wave 7, 2014/2015). Baseline data were from the wave prior to FOBT invitation, and follow-up data were from the next consecutive wave (two years later).

Methods: The effects of FOBT participation, time and group-by-time interactions on health behaviours were investigated using generalised estimating equations. Almost two-thirds of the sample (62.5%; n = 484) had participated in FOBT.

Results: Screening participants were less likely to smoke (odds ratio (OR): 0.45, 95% confidence interval (CI): 0.29–0.68) and more likely to meet fruit and vegetable consumption guidelines (OR: 1.70, 95% CI: 1.14–2.55). Smoking decreased over time (OR: 0.74, 95% CI: 0.62–0.89), but adherence to alcohol guidelines also decreased (OR: 0.71, 95% CI: 0.53–0.91). A group-by-time interaction was found for vigorous physical activity; the odds of taking part in vigorous physical activity increased for FOBT participants, but decreased for non-participants (OR: 1.40, 95% CI: 1.01–1.95).

Conclusions: This research provides tentative support for FOBT as a teachable moment for increasing vigorous physical activity. However, overall, there was limited evidence for spontaneous improvement in multiple health behaviours following participation.

Keywords
Cancer screening, teachable moment, smoking, alcohol, physical activity, diet, colorectal cancer, cohort

Date received: 5 April 2018; accepted: 10 September 2018

Introduction

Population cancer screening has been described as a ‘teachable moment’ for health behaviour change.¹ The term is used to describe opportunities to facilitate behaviour change, and situations where behaviour change may occur spontaneously.² Research has investigated whether, without intervention, participation in cancer screening prompts positive changes to cancer-related health behaviours. One study, set within a UK flexible sigmoidoscopy trial, showed rates of physical activity (PA) and fruit and vegetable intake increased, and smoking rates decreased following participation.³

There is a concern that participation in cancer screening may have a negative impact on health behaviour change, by means of a ‘Health Certificate Effect’.⁴ In one colorectal cancer screening trial, improvements in health behaviours were observed across the sample, but it was the unscreened population that made greater improvements for smoking, PA and fruit and vegetable consumption.⁵,⁶ If this is the case, the unintentional effects of cancer screening participation on lifestyle may have an impact on the cancer prevention efforts and mortality reduction of...
cancer screening programmes. One systematic review found little evidence that negative screening results provide false reassurance to participants, although the included studies were limited in both number and quality. Two systematic reviews have concluded that there is also little support for the idea that spontaneous positive behaviour change can occur following cancer screening participation. The literature is limited to studies exploring the effect of lung screening on smoking, with very few studies observing multiple health behaviours within the context of other cancer screening modalities. Additionally, few studies have compared behavioural changes among screening attendees with those of non-attendees. Studies that have included a control group have generally involved samples participating in cancer screening trials, who may be more health conscious and motivated to change their behaviour compared with population screening programme participants.

Within existing cancer screening programmes, previous research has not distinguished between participants with and without prior experience of cancer screening. In the context of cardiovascular screening, first participation in health screening is most effective at prompting behaviour change.

Prior to the recent implementation of flexible sigmoidoscopy screening, men received their first invitation to an National Health Service (NHS) cancer screening programme (focal occult blood testing; FOBT) at the age of 60. Therefore, men invited to participate in FOBT are a distinct group, and offer the least biased sample to investigate the topic of teachable moments in a cancer screening context. This study aimed to investigate whether first participation in the English NHS FOBT cancer screening programme is associated with spontaneous lifestyle changes among attenders, compared with non-attenders, in a screening-naive population of men from an English prospective cohort study.

Methods
Data were taken from the English Longitudinal Study of Ageing (ELSA), a biennial prospective cohort study of English adults aged over 50. The cohort was originally sampled from the Health Survey for England, with refreshment samples recruited to maintain adequate sample size and representativeness. Data were collected using computer-assisted personal interviews and self-complete questionnaires. The most recent data (wave 7) were collected in 2014–2015.

Men approaching the age of their first invitation to participate in FOBT were included in analyses. FOBT is offered biennially, via a postal home-test kit, to men and women aged 60–74, who receive their first invitation to participate shortly after their 60th birthday. Prior to the postal home-test kit, participants receive an invitation letter with a leaflet explaining the test. The leaflet highlights, weight, lack of exercise and dietary factors as bowel cancer risk factors. The home-test kit involves providing three sets of stool samples over a 10-day period. Participants' baseline data (prior to first invitation) were taken from the wave at which they were aged 57–59. Three waves of data were used to identify baseline groups: wave 4 (2008–2009; n = 210), wave 5 (2010–2011; n = 280) and wave 6 (2012–2013; n = 284, total n = 774). Wave 4 included fewer participants, as questions relating to FOBT were included part-way through data collection. The next consecutive wave of data for each participant (waves 5, 6 and 7, respectively) provided follow-up data (following first FOBT invitation). At follow-up, participants were aged 60–61. Participants outside this age range were excluded to ensure that they had been invited to participate in FOBT once only. Participants who reported a diagnosis of cancer at either time-point were excluded.

Participation in FOBT was defined as answering 'yes' to the question 'Have you ever completed the NHS bowel cancer screening test using the home test kit?'. Data for ethnicity, education and occupation were taken from a person's baseline wave. Ethnicity was categorised into white and non-white. Based on the highest level of educational qualification achieved, education was categorised into no formal qualifications, qualifications below degree level and education at degree level or above. Occupation was categorised into managerial or professional, intermediate, routine or manual and other. Baseline and follow-up data were used for demographic variables likely to change over time. For retirement status, participants were categorised as retired or not retired at each time-point. Participants were asked whether they had a long-standing illness (yes/no) and whether it was life-limiting (yes/no): used to categorise participants as having a long-standing illness which was life-limiting or not.

Participants were categorised as current smokers if they answered 'yes' to the question 'Do you smoke at all nowadays?' Participants were asked to record the number of measures of (1) spirits, (2) glasses of wine and (3) pints of beer, larger, or cider they had consumed in the past week.

Based on NHS guidelines for alcohol consumption, participants were categorised as meeting guidelines for alcohol consumption if they had consumed 14 or fewer alcoholic units in the past week. From wave 5 onwards, two items assessed fruit and vegetable consumption: 'How many portions of vegetables – excluding potatoes – do you eat on a typical day?' and 'How many portions of fruit – of any kind – do you eat on a typical day?'. Responses were combined to create a composite measure of fruit and vegetable consumption. Participants who consumed five or more portions each day were categorised as meeting UK guidelines. Different, non-comparable items were used prior to wave 5, meaning analyses of this variable used a reduced sample. Levels of moderate physical activity (MPA) and vigorous physical activity (VPA) were assessed using two variants of the same item: 'Do you take part in any sports that are (vigorous/moderately energetic)' with response options of 'more than once a week', 'once a
week ', ‘one to three times a month', ‘hardly ever or never'. The response options 'more than once a week' and 'once a week' were combined to determine the proportion of people participating in VPA and MPA once or more per week. UK PA guidelines advise adults should participate in at least 150 min of MPA or 75 min of VPA per week.\textsuperscript{19}

Data were described using means and proportions. Multivariate logistic regression was used to determine demographic predictors of FOBT participation. To investigate the effect of FOBT participation on the lifestyle factors, five separate generalised estimating equations (GEE) were used. GEE is a method used to analyse longitudinal data allowing for the estimation of differences between groups (FOBT participants vs. non-participants) for an outcome, changes to an outcome over time and group-by-time interactions.\textsuperscript{20} Each GEE model included two main effects (group, time) and an interaction effect (group × time) and was adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status and baseline wave. The main effect for time shows whether, across the whole sample, lifestyle factors changed between baseline and follow-up. The main effect for group shows whether, across both time points, there are any differences between groups (FOBT participants/FOBT non-participants). The interaction effect assesses whether FOBT participants changed their behaviour to a greater or lesser degree than FOBT non-participants. Proportions reported alongside GEE analyses are adjusted for all demographic covariates. Statistical analyses were carried out in Stata SE 14. Previous research using this cohort and methodology has investigated lifestyle changes following a cancer diagnosis.\textsuperscript{21}

Results

Of the sample (n = 774), 62.5% (n = 484) reported participating in FOBT at follow-up, 95.1% (n = 736) were white and 27.7% (n = 213) were educated to degree level or above (Table 1). Among those who were employed, 46.7% (n = 345) worked in managerial and professional occupations. Percentage of participants reporting having a life-limiting long-standing illness were 24.3% (n = 184) at baseline and 24.4% (n = 189) at follow-up. Retirement increased from 12.5% (n = 95) at baseline to 24.3% (n = 188) at follow-up. Multivariate logistic regression including baseline and follow-up demographic characteristics revealed that retirement status at follow-up positively predicted FOBT participation (odds ratio (OR): 1.99, 95% confidence interval (CI): 1.25-3.15). No other demographic factors were associated with FOBT participation.

- **Smoking (n = 736):** The proportion of current smokers decreased over time (OR: 0.74, 95% CI: 0.62-0.89) from 14.9% to 12.7% (Figure 1). Fewer FOBT participants identified as smokers compared with FOBT non-participants (OR: 0.45, 95% CI: 0.29-0.68). No group-by-time interaction was observed for smoking behaviour (OR: 1.15, 95% CI: 0.90-1.47), indicating

| Table 1 Demographic characteristics of the total sample, FOBT participants and non-participants, with multivariate analyses to identify demographic predictors of FOBT participation. |
|-----------------------------------------------|--------|--------|--------|-----------------|
| Total sample % (n) | FOBT participants % (n) | FOBT non-participants % (n) | Adjusted odds ratio (95% CI) |
| Ethnicity (n=774) | | | |
| White | 95.1 (736) | 94.0 (460) | 95.2 (276) | REF |
| Nonwhite | 4.9 (38) | 5.0 (24) | 4.8 (14) | 1.17 (0.57-2.43) |
| Baseline education (n=770) | | | |
| Degree level or above | 27.7 (213) | 30.9 (149) | 22.2 (64) | REF |
| Qualifications below degree | 58.4 (450) | 56.4 (272) | 61.8 (178) | 0.77 (0.51-1.16) |
| No formal qualifications | 13.9 (107) | 12.7 (64) | 16.0 (46) | 0.75 (0.42-1.35) |
| Baseline occupation (n=739) | | | |
| Managerial and professional | 46.7 (345) | 49.8 (222) | 41.4 (113) | REF |
| Intermediate | 21.2 (157) | 21.2 (99) | 21.3 (58) | 1.02 (0.66-1.58) |
| Routine and manual | 31.8 (235) | 28.8 (134) | 37.0 (101) | 0.82 (0.55-1.24) |
| Other | 0.3 (2) | 0.2 (1) | 0.4 (1) | 0.57 (0.34-0.93) |
| Baseline long-standing illness (n=756) | | | |
| No | 75.7 (572) | 76.7 (26.18) | 73.8 (103) | REF |
| Yes | 24.3 (184) | 23.3 (112) | 26.2 (172) | 1.03 (0.65-1.65) |
| Follow-up long-standing illness (n=774) | | | |
| No | 75.6 (585) | 77.9 (537) | 71.7 (208) | REF |
| Yes | 24.4 (189) | 22.1 (107) | 28.3 (82) | 0.80 (0.50-1.29) |
| Baseline retirement (n=761) | | | |
| Not retired | 87.5 (666) | 87.3 (418) | 87.9 (248) | REF |
| Retired | 12.5 (95) | 12.7 (61) | 12.1 (34) | 0.65 (0.37-1.15) |
| Follow-up retirement (n=774) | | | |
| Not retired | 75.7 (586) | 71.9 (348) | 82.1 (238) | REF |
| Retired | 24.3 (188) | 28.1 (138) | 17.9 (52) | 1.99 (1.25-3.15) |
that men who participated in FOBT did not change their behaviour any more or less than non-participants.

- **Alcohol consumption** (n = 714): The proportion of men meeting current alcohol consumption guidelines decreased over time (Figure 2). From 65.9% to 61.6% (OR: 0.69, 95% CI: 0.53–0.91). There was no difference in adherence to alcohol guidelines between the screened and non-screened groups (OR: 0.87, 95% CI: 0.62–1.23). No group-by-time interaction was observed for alcohol consumption (OR: 1.34, 95% CI: 0.96–1.85). Compared with FOBT non-participants, FOBT participants were no more or less likely to change their alcohol consumption over time.

- **Fruit and vegetable consumption** (n = 524): The proportion of participants meeting guidelines for fruit and vegetable consumption did not change over time (45.0% vs. 52.7%; OR: 1.32, 95% CI: 0.91–1.90) (Figure 3). Participants who took part in FOBT had greater odds of meeting fruit and vegetable consumption guidelines across both time points, compared with non-participants (OR: 1.70, 95% CI: 1.14–2.55). There was no interaction between group and time for fruit and vegetable consumption (OR: 1.02, 95% CI: 0.66–1.58). FOBT participants and non-participants were equally likely to change their behaviour.

- **Physical activity**: The proportion of men taking part in MPA once or more per week did not change between baseline (88.6%) and follow-up (85.5%) measurements (n = 736; OR: 0.75, 95% CI: 0.49–1.15) (Figure 4). No differences in MPA were observed between FOBT participants and non-participants.
Figure 3. Proportion of men meeting guidelines for fruit and vegetable consumption over time, comparing FOBT participants and FOBT non-participants (n = 524; FOBT participants n = 347, FOBT non-participants n = 177). Proportions adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status and baseline wave. This analysis includes a smaller sample size due to different, non-comparable items assessing fruit and vegetable consumption prior to wave 5.
FOBT: fecal occult blood testing.

Figure 4. Proportion of men taking part in MPA (n = 736; FOBT participants n = 465, FOBT non-participants n = 271) and VPA (n = 734; FOBT participants n = 464, FOBT non-participants n = 270) once or more per week, over time, comparing FOBT participants and FOBT non-participants (proportions adjusted for ethnicity, occupation, education, limiting long-standing illness, retirement status, and baseline wave).
FOBT: fecal occult blood testing; MPA: moderate physical activity; VPA: vigorous physical activity.

participants and FOBT non-participants (OR: 1.08, 95% CI: 0.69–1.71). There was no group-by-time interaction (OR: 0.97, 95% CI: 0.57–1.67). The proportion of men taking part in VPA once or more per week did not change between baseline (40.1%) and follow-up (41.2%) measurements (n = 734; OR: 0.83, 95% CI: 0.64–1.01). There was no main effect of group on the proportion of men participating in VPA once or more per week (OR: 0.79, 95% CI: 0.57–1.08). A group-by-time interaction was found (OR: 1.40, 95% CI: 1.01–1.95) (Figure 4). Among men who participated in FOBT, the proportion taking part in VPA once or more per week increased over time (38.7% to 43.2%). For FOBT non-participants, the proportion taking part in VPA once or more per week decreased over time (41.6% to 37.5%).

Discussion
In this cohort of men, we did not find evidence of spontaneous lifestyle changes following first FOBT participation for smoking, alcohol consumption, fruit and vegetable intake, nor MPA. A modest increase in VPA among FOBT attendees provides tentative support for screening participation as a teachable moment for PA, but effect sizes were small.
These results are in line with most studies in this area that have not observed spontaneous changes in behaviour following cancer screening participation.10,11 Our study adds more robust evidence that screening is unlikely to prompt improvements for most behaviours, as it used a prospective cohort design, with a sample that is more representative of the general population compared with previous research. We also controlled for retirement, which may be related to both levels of physical activity and FOBT uptake.22,23 The finding that VPA may increase after participating in colorectal cancer screening is similar to a previous study, which observed changes to PA following participation in a bowel scope trial.7 The same study also observed positive changes to smoking behaviour and fruit and vegetable consumption. Our study, which included a non-screened comparison group, found that smoking decreased among FOBT attendees and non-attendees. This suggests that although smoking appears to reduce over time, FOBT participation is unlikely to be the catalyst for change.

Previous research has found that MPA and VPA reduce with age within the ELSA cohort, and interventions to increase PA among adults are generally only modestly effective.24,25 It is therefore encouraging that, in our sample, screening attendees appeared to increase their VPA. This effect needs to be replicated in additional cohorts, although it is possible that FOBT screening may provide a teachable moment, prompting spontaneous change for this behaviour. MPA remained stable over time and did not decrease as VPA increased.26 However, almost 90% of the sample reported engaging in MPA once or more per week at baseline, suggesting a ceiling effect. Research exploring the mechanisms involved in creating teachable moments is sparse. It has been theorised that changes to a number of constructs including perceived risk, affect and self-concept may prompt behaviour change.27

Despite an absence of evidence to support positive changes to multiple health behaviours following FOBT screening, our research does not support the suggestion of a health certificate effect.6,7 It has been suggested that positive behaviour change following screening may be observed predominantly among people who receive abnormal screening outcomes.18 Although screening results were unknown for our participants, the exclusion of participants with a diagnosis of cancer means it is likely that the majority received a normal screening result. Only 2.5% of men will receive an abnormal result; therefore, studies with larger sample sizes are needed to determine whether FOBT result has an impact on behaviour change.28

In line with previous research,29 FOBT participants were less likely to smoke, and more likely to meet guidelines for fruit and vegetable consumption, compared with non-participants. Health behaviours have been found to cluster.30 and this may reflect greater health awareness among this group. However, although the FOBT group displayed healthier behaviours than the non-screened group, health behaviours were sub-optimal. The proportion of men consuming alcohol in excess of current guidelines increased from baseline to follow-up, suggesting there may be a need for interventions targeting this behaviour among men in this age group. In line with recent public health initiatives, such as Making Every Contact Count,31 cancer screening could provide an opportunity to deliver interventions.1

Previous, more intensive, behaviour change interventions in the screening context have predominantly targeted patients with screen-detected polyps; however, most people will receive a normal screening result. Trials of these interventions, aimed at promoting diet, PA and weight loss, have documented encouraging changes to behaviour.32-34 Trials are needed to test interventions delivered during different screening procedures, and the feasibility of delivering this kind of information to all screening attendees.

The ELSA is said to be broadly representative of British older adults.36 We compared our participants with 2011 Census data (limited to English men, aged 60-64) for two key demographic variables: ethnicity and education. The proportion of white participants (Census = 94.4%, ELSA = 95.1%) and participants with education to degree level or above (Census = 25.2%, ELSA = 27.7%) were similar. While our sample appears to be broadly representative of men aged 60-64 for ethnicity and education, our findings may not be generalisable to other groups. It is important to determine if the findings observed in this study are similar for attendees of other screening programmes, for women, and for non-naive attendees.

Within our sample, self-reported uptake of FOBT was 63%, compared with 54% uptake in the general population.35 Estimates of the accuracy of self-reported FOBT uptake vary, with some research suggesting it can be highly accurate, and others noting a 13% overestimation.36,37 Despite the ELSA being broadly representative for demographic factors, it is possible that certain health behaviours, such as screening participation, are over-represented. ELSA participants may be more health conscious, and therefore more likely to take part in cancer preventive behaviours, or taking part in the ELSA may have an impact on health behaviours. We do not have any information on reasons for FOBT non-participation. It is likely that these individuals chose not to participate, as opposed to missing an invitation, but this cannot be confirmed.

There are differences in how behaviour change is measured at cancer screening, with some research assessing change across a combined behavioural score.38 Our research examined the impact of screening on individual behaviours; however, the ELSA did not include measures of all behavioural risk factors for bowel cancer, such as the consumption of red and processed meat, with fruit and vegetable consumption the only measure of diet. The items used to measure VPA and MPA meant that it was
impossible to determine if people were meeting guidelines, and made it difficult to accurately gauge changes in PA. National estimates of PA are usually based on the number of minutes of MPA and VPA completed per day or week.\textsuperscript{79} Research using objective measures of health behaviours is needed, to explore whether the changes observed in this study are reliable. Despite offering a different perspective from research conducted within screening trials, using a prospective cohort research design prevents confirmation of causality. Finally, this research design may fail to capture transient changes in health behaviours which might be made following cancer screening. Therefore, more research is needed to understand the timeline of the teachable moment in the cancer screening context.

Conclusion

FOBT participation did not appear to prompt long-standing, spontaneous, positive changes to multiple health behaviours within this sample of male ELSA participants, although modest spontaneous behaviour change was observed for VPA. FOBT participation did not appear to discourage behaviour change. Future research should investigate whether spontaneous lifestyle changes occur across other cancer screening programmes, the mechanisms involved in creating the teachable moment and the appetite for lifestyle advice in the cancer screening setting.

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Declaration of conflicting interests

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References

## Appendix C. Items from the English Longitudinal Study of Aging

<table>
<thead>
<tr>
<th>Topic</th>
<th>Item/s</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic items</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>What was your age last birthday?</td>
</tr>
<tr>
<td>(computer assisted</td>
<td></td>
</tr>
<tr>
<td>personal interview)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>To which of the groups on this card do you consider that you belong?</td>
</tr>
<tr>
<td>(computer assisted</td>
<td>(Card with response options shown to participant)</td>
</tr>
<tr>
<td>personal interview,</td>
<td>1. White</td>
</tr>
<tr>
<td>derived variable)</td>
<td>2. Mixed ethnic group</td>
</tr>
<tr>
<td></td>
<td>3. Black</td>
</tr>
<tr>
<td></td>
<td>4. Black British</td>
</tr>
<tr>
<td></td>
<td>5. Asian</td>
</tr>
<tr>
<td></td>
<td>6. Asian British</td>
</tr>
<tr>
<td></td>
<td>7. Any other group</td>
</tr>
<tr>
<td></td>
<td>[derived variable: ethnicity recoded into White or non-White]</td>
</tr>
<tr>
<td>Education</td>
<td>What is the highest qualification you have obtained up to now?</td>
</tr>
<tr>
<td>(computer assisted</td>
<td>1. nvq4/nvq5/degree or equiv</td>
</tr>
<tr>
<td>personal interview,</td>
<td>2. higher ed below degree</td>
</tr>
<tr>
<td>derived variable)</td>
<td>3. nvq3/gce a level equiv</td>
</tr>
<tr>
<td></td>
<td>4. nvq2/gce o level equiv</td>
</tr>
<tr>
<td></td>
<td>5. nvq1/cse other grade equiv</td>
</tr>
<tr>
<td></td>
<td>6. foreign/other</td>
</tr>
<tr>
<td></td>
<td>7. no qualification</td>
</tr>
<tr>
<td>Occupation</td>
<td>Derived from HSE data and categorised into three classes (NSSEC3)</td>
</tr>
<tr>
<td>(computer assisted</td>
<td>1. Managerial and professional occupations</td>
</tr>
<tr>
<td>personal interview,</td>
<td>2. Intermediate occupations</td>
</tr>
<tr>
<td>derived variable)</td>
<td>3. Routine and manual occupations</td>
</tr>
<tr>
<td>Retirement status</td>
<td>Which one of these, would you say best describes your current situation?</td>
</tr>
<tr>
<td>(computer assisted</td>
<td>1. Employee</td>
</tr>
<tr>
<td>personal interview)</td>
<td>2. Self-employed</td>
</tr>
<tr>
<td></td>
<td>3. Retired</td>
</tr>
<tr>
<td></td>
<td>4. Unemployed</td>
</tr>
<tr>
<td></td>
<td>5. Permanently sick or disabled</td>
</tr>
<tr>
<td></td>
<td>6. Looking after home or family</td>
</tr>
</tbody>
</table>
7. Other

**Health related items**

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life-limiting long standing illness</strong></td>
<td>Q1. Yes/No</td>
</tr>
<tr>
<td><em>(computer assisted personal interview)</em></td>
<td>Q2. Yes/No</td>
</tr>
<tr>
<td><strong>FOBT participation</strong></td>
<td>Have you ever completed a home testing kit for screening bowel cancer?</td>
</tr>
<tr>
<td><em>(computer assisted personal interview)</em></td>
<td><strong>Smoking</strong></td>
</tr>
<tr>
<td><em>(computer assisted personal interview)</em></td>
<td><strong>Alcohol consumption</strong></td>
</tr>
<tr>
<td><em>(self-complete questionnaire)</em></td>
<td>Q2. Yes/No</td>
</tr>
<tr>
<td><strong>Alcohol consumption</strong></td>
<td>Q3. Yes/No</td>
</tr>
<tr>
<td><em>(self-complete questionnaire)</em></td>
<td>Q4. Yes/No</td>
</tr>
</tbody>
</table>

Q1. Do you have any long-standing illness, disability or infirmity? By long-standing I mean anything that has troubled you over a period of time, or that is likely to affect you over a period of time.
1. Yes
2. No

Q2. Does this illness / these illnesses or disability / disabilities limit your activities in any way?
1. Yes
2. No

Have you ever completed a home testing kit for screening bowel cancer?
1. Yes
2. No

Do you smoke at all nowadays?
1. Yes
2. No

Q1. Did you have an alcoholic drink in the seven days ending yesterday?
1. Yes
2. No

Q2. During the last seven days, how many measures of spirits did you have? Drinks poured at home may be larger than a pub single measure – please estimate number of singles. If none, please enter ‘0’.
(Blank response box)

Q3. During the last seven days, how many glasses of wine did you have? Include sherry, port, vermouth. If none, please enter ‘0’.
(Blank response box)

Q4. During the last seven days, how many pints of beer, lager or cider did you have? If none, please enter ‘0’.
(Blank response box)
| **Fruit and vegetable consumption**  
** (self-complete questionnaire) | Q1. How many portions of vegetables – excluding potatoes – do you eat on a typical day? If none, please enter ‘0’.

*A serving or portion of vegetables means three heaped tablespoons of green or root vegetables such as carrots, parsnips, spinach, small vegetables like peas, baked beans or sweet corn, or a medium bowl of salad (lettuce, tomatoes, etc).*

(blank response box)

Q2. How many portions of fruit – of any kind – do you eat on a typical day? If none, please enter ‘0’.

*A portion of fruit is an apple or banana, a small bowl of grapes, or three tablespoons of tinned or stewed fruit. If you drink fruit juice, you can count one glass per day, but additional glasses of fruit juice do not count as additional portions.*

(blank response box) |
| **Physical activity**  
**(computer assisted personal interview)** | Q1. Do you take part in sports or activities that are vigorous...

1. More than once a week
2. Once a week
3. One to three times a month
4. Hardly ever, or never

Q2. Do you take part in sports or activities that are moderately energetic...

1. More than once a week
2. Once a week
3. One to three times a month
4. Hardly ever, or never

Q3. Do you take part in sports or activities that are mildly energetic...

1. More than once a week
2. Once a week
3. One to three times a month
4. Hardly ever, or never |
Appendix D. Publication: Acceptability of receiving lifestyle advice at cervical, breast and bowel cancer screening

Acceptability of receiving lifestyle advice at cervical, breast and bowel cancer screening

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Abstract

Cancer screening could be an opportunity to deliver cancer prevention advice, but it is not known how much information would be received. We explored willingness to receive lifestyle advice in the context of the National Health Service cervical, breast, and bowel (FIT, flexible sigmoidoscopy) screening programmes. A population-based survey was conducted in 2016 to collect nationally representative data on willingness to receive lifestyle advice across cervical (n = 748), breast (n = 42) and FOBT (n = 200) screening programmes. Additional items assessed the impact of lifestyle advice on screening attendance, preferences for receiving advice in the event of an abnormal screening result, and timing of advice. Most respondents were willing to receive lifestyle advice around the time of cancer screening (cervical: 74.8%, breast: 73.4%, FOBT: 41.8%), and lifestyle views were abnormal (cervical: 86.9%, breast: 93.9%, FOBT: 65.3%). A small proportion indicated it may discourage future attendance (cervical: 4.9%, breast: 7.9%, FOBT: 8.8%). Most preferred to receive advice at the screening appointment (cervical: 66.6%, breast: 72.4%, FOBT: 70.7%). There were no associations between sociodemographic characteristics and willingness to receive lifestyle advice at breast screening. For those intending to attend cervical screening, more women and higher education were associated with increased willingness to receive lifestyle advice. Women were more likely to be willing to receive advice at FO screening than men. Providing lifestyle advice at cancer screening is likely to be acceptable to the general population. The optimal approach for delivery needs careful consideration to minimise potential negative effects or screening attendance.

1. Introduction

In 2014 there were 350,000 cancer diagnoses in the UK, and by 2035 annual diagnoses are expected to exceed 599,000 (Cancer Research, 2016; Andriessen et al., 2013). The link between lifestyle and the development of many common cancers is well established (Brown et al., 2019). Tobacco use is the single greatest cancer risk factor, however, the contribution of risk factors varies by cancer type. For example, the greatest risk factors for colorectal cancer include overweight, dietary factors, alcohol and tobacco use (Brown et al., 2019). Consequently, the importance of behavioural cancer prevention strategies is recognised (The Independent Cancer Taskforce, 2015).

Cancer screening has been described as a 'reachable moment', providing an opportunity to deliver cancer prevention advice and interventions (Kennet et al., 2018). Cancer screening and risk factor reduction both impact cancer mortality (Edwards et al., 2010). Combined, the two approaches are likely to have the greatest effects (Osoba et al., 2012). Providing lifestyle advice alongside cancer screening is consistent with English policy to 'Make Every Contact Count' by utilising interactions with the public to support health and wellbeing (Public Health England, 2016b). However, there is little evidence that cancer prevention advice is delivered routinely alongside cancer screening in the UK (Andriessen et al., 2013).

Recent evidence suggests interventions can be delivered alongside cancer screening (Anderson et al., 2015; Serre et al., 2015). Interventions delivered at breast screening have promoted weight loss (Anderson et al., 2014; Fredendahl et al., 2011). Low-intensity interventions delivered alongside bowel screening (FIT, flexible sigmoidoscopy) have increased reported fruit and vegetable consumption within a screening trial setting (Robb et al., 1999; Anderson et al., 2010). At cervical screening, interventions targeting motivation to quit smoking and smoking cessation have produced mixed results (Chukwu et al., 2012; Garrigan et al., 2012; Halk et al., 2012; McBride et al., 1999).

There is concern that delivering information and interventions alongside screening could compromise uptake. Screening uptake varies within England, with FOBT uptake (49%) considerably lower than lowest
(71%), and cervical screening (75%). [Health and Social Care Information Centre, 2016, 2019; McGregor et al., 2016]. There is a socioeconomic gradient in screening participation, whereby more deprived populations are less likely to attend than less deprived populations [O’brien et al., 2015; McGregor et al., 2016; van Wagner et al., 2011]. There are also associations between ethnicity and screening attendance, with ethnic minority groups less likely to participate [McGregor et al., 2016; Munir et al., 2009; van Wagner et al., 2011]. It is therefore important to explore sociodemographic determinants of intent in advice on cervical screening and anticipated changes in screening behaviour if lifestyle advice were routinely offered in NHS (National Health Service) screening programmes.

The acceptability of information delivered at population-based screening has been explored within the context of breast and cervical screening. A study of women attending mammography found 85% reported interest in receiving information about diet and exercise at breast screening clinics, and that this information was unlikely to impact future attendance [Furler et al., 2007]. Similarly, a qualitative study of women who had attended breast screening reported most women were positive about receiving information about reducing body fat, alcohol consumption and physical activity at screening [Cawney et al., 2016]. One study tailored the delivery of a magazine designed to provide information about lifestyle and cancer prevention to women attending breast screening clinics [McClelland and Andrews, 2013]. Uptake was high among women who were actively offered the magazine (95%). Smoking cessation advice appears to be acceptable when delivered at cervical screening [Boll et al., 2007]; most participants still intended to attend subsequent cervical screening appointments.

Using a population representative sample of English adults, this study used hypothetical scenarios to explore willingness to receive lifestyle advice alongside cervical, breast, and FS screening. These screening modalities were selected as they involve interactions between patients and healthcare professionals, which has been suggested as important in the teachable moment [Roosla and Flocke, 2009]. This research sought to understand whether willingness to receive information around the time of screening differs according to the type of screening result received. We also investigated anticipated future screening behaviours if lifestyle advice were offered, and sociodemographic correlates of willingness to receive information. Finally, this research aimed to identify the preferred timing of advice during the screening process.

2. Methods

2.1. Design

Data were collected as part of a cross-sectional population representative survey on the determinants of early detection and prevention behaviours related to cancer. Face-to-face computer assisted interviews were conducted as part of an omnibus survey run by market research agency Taylor Nelson Sofres (TNS) in April and May 2015. Ethical approval was granted by the University College London Research Ethics Committee (Ref: 5777/002). Verbal consent was obtained at the start of interviews.

2.2. Participants

Random location sampling using 2011 Census data and Postcode Address File data was used to identify participants. Quota were set for demographic characteristics to ensure a nationally representative sample. Questions relating to lifestyle advice at cancer screening were limited to three sub-samples. In line with current screening guidelines in England, women aged 25-54 (n = 758) were asked questions about cervical screening and women aged 47-70 were asked questions about breast screening (n = 410). Questions about bowel scope screening were asked of men and women aged 45-54 (n = 308). In England, people are invited to a one-off bowel scope screening appointment at the age of 55. So that intention to attend screening and the impact of advice on future screening attendance could be measured, questions relating to bowel scope screening were only asked of people approaching screening age.

2.3. Measures

2.3.1. Sociodemographic variables

Data were collected for age, gender, ethnicity and educational attainment (as a marker of social position). Ethnicity was categorised into White (including participants who identify as White British, White Irish, White Other and Other White groups) and non-White, based on UK Census ethnicity classifications. Education was measured using the item 'what is the highest level of educational qualification you have obtained' with responses categorised into degree level or above/for people who have obtained an undergraduate bachelor’s degree or above and education below degree level.

2.3.2. Cancer screening intention

Intention to participate in cancer screening was asked separately for the three programmes. Before answering questions about each screening modality, participants were shown a written and pictorial description of the screening programme. For cervical screening, women were asked 'Will you go for cervical screening next time you are invited?'. For breast screening, women were asked 'Will you go for breast screening when, or next time you are invited?'. For FS screening, people were asked 'Would you take up the offer for bowel scope screening if you were invited?'. Four response options were offered (Yes, definitely; Yes, probably; No, probably not; No, definitely not). Responses were dichotomised into yes and no. Participants who did not intend to attend cancer screening were excluded from further analyses.

2.3.3. Willingness to receive lifestyle advice at cancer screening

For those intending to attend any of the screening programmes, willingness to receive lifestyle advice was measured using three versions of the item 'Would you be willing to receive advice about making healthy lifestyle changes (for example, diet or physical activity) as part of the cervical/breast/bowel screening programme?'. Five response options were offered which categorised participants as willing (Yes, definitely; Yes, probably), or not (No, probably not; No, definitely not; No, unsure). Responses were dichotomised in two participants selected the three latter response options. For each screening programme, an additional question assessed interest in lifestyle advice in the event of a screening result which required further investigations ‘Would you be willing to receive lifestyle advice if your screening result suggests you need to have further investigations?’. The same response options were used for this item.

2.3.4. Impact of lifestyle advice on cancer screening participation

All participants eligible to attend any of the three screening programmes were asked ‘If you knew you would receive advice about lifestyle as part of the cervical/breast/bowel screening programmes, would this affect your willingness to attend cervical/breast/bowel screening?’. Three response options were provided (Yes, I would be more willing to attend; Yes, I would be less willing to attend; No, it would not affect my willingness to attend).}

6 Cognitive interviews (n = 14) were used to assess the comprehension, clarity and acceptability of individual items. Finalised items were piloted online prior to inclusion in the final survey (n = 562).
participants who were intending to attend screening and willing to receive lifestyle advice. When would you prefer to receive lifestyle advice as part of the cervical/breast/PS screening programme?* Five response options were provided: at the same time as my screening appointment, with my screening results, 2-4 weeks after attending screening, 1-3 months after attending screening, >3 months after attending screening.

Participants were asked questions relating to all of the screening programmes they were eligible for, meaning women were asked about up to three screening programmes, whereas men were asked about just one.

2.4. Analysis

Descriptive analyses explored willingness to receive information around the time of screening, the effect of information provision on screening uptake and timing preferences. Three McNemar's tests explored differences between interest in lifestyle advice around screening in general and interest in the event that further investigations were required. Three logistic regression models were conducted, simultaneously entering age, gender, ethnicity, and education to identify sociodemographic correlates of willingness to receive lifestyle advice at cervical, breast, and bowel PS Cancer screening. Weights were used to ensure population representativeness. These were calculated by market research company TNS and based on age, region, social grade and working status. Sample characteristics are presented unweighted and weighted. Univariate and bivariate analyses are presented weighted. Multivariate analyses are presented unweighted. Where significance testing is necessary for the interpretation of results an alpha level of 0.05 was used.

3. Results

3.1. Sample characteristics

A total of 1,037 (weighted N = 16,413) participants were included in the analyses (Table 1). The mean age of the analytic sample was 47.6 years (SD 12.1). Most were female (51.1%, n = 944), reflecting the screening modalities studied. The majority were white (85.7%, n = 883) and estimated at below degree level (50.0%, n = 543). The cervical screening sample included 768 women aged 25-76 (weighted n = 1,793), the breast screening sample included 426 women aged 45-70 (weighted n = 1,404), and the PS screening sample included 416 men and women aged 45-74 (weighted n = 386).

3.2. Willingness to receive lifestyle advice at cervical screening

Intention to participate in the three cancer screening programmes was high (cervical 93.4%, n = 651; breast 94.6%, n = 378; PS 97.9%, n = 211). Of those intending to attend cervical screening, most were willing to receive lifestyle advice alongside the NHS cervical screening programme (79.0%, n = 652). However, a greater proportion of this group were willing to receive advice if they received an abnormal screening result (85.3%, n = 558; McNemar's χ² 22.0, df = 644, p < 0.001). Most women who intended to attend breast screening were willing to receive lifestyle advice alongside breast screening (79.0%, n = 360) (Table 2). A similar proportion of this group indicated they would be willing to receive advice if they received an abnormal screening result (85.0%, n = 262). McNemar's χ² 23.3, df = 374, p = 0.087. For those intending to attend PS the majority (84.9%, n = 252) were willing to receive lifestyle advice alongside bowel cancer screening. A similar proportion of this group were willing to receive advice if they received an abnormal screening result (84.9%, n = 252; McNemar's χ² 2.5, df = 367, p = 0.143).

3.3. Sociodemographic correlates of willingness to receive lifestyle advice

Eligibility and educational attainment were associated with willingness to receive advice at cervical screening (Table 3). Compared with white participants, non-white participants had greater odds of being willing to receive lifestyle advice (94.4% vs 77.0%; OR 2.39, 95% CI 1.16-4.93). Participants who reported education below degree level had lower odds of being willing to receive lifestyle advice at cervical

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic characteristics of the total analytic sample and subsamples for the cervical, breast, and PS screening scenarios.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cervical screening sample</td>
</tr>
<tr>
<td>Total analytic sample</td>
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<tr>
<td>(n = 1037)</td>
<td>(n = 1037)</td>
</tr>
<tr>
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<tr>
<td>45-50</td>
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</tr>
<tr>
<td>51-55</td>
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<td>56-60</td>
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<tr>
<td>61-65</td>
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<td>76-80</td>
<td>11.7</td>
</tr>
<tr>
<td>Gender &amp;</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Ethnicity* &amp;</td>
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<tr>
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<tr>
<td>Education level &amp;</td>
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<tr>
<td>Degree level or above</td>
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<tr>
<td>Below bachelor's degree level</td>
<td>76.6</td>
</tr>
<tr>
<td>Intention to attend screening &amp;</td>
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</tr>
<tr>
<td>Intends</td>
<td>44.4</td>
</tr>
<tr>
<td>Does not intend</td>
<td>55.6</td>
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</table>

* Race not specified.

Based on dichotomization of UK census classifications.
Table 2

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<tr>
<th>Willing to receive lifestyle advice at cervical screening</th>
<th>Willing to receive lifestyle advice if further investigations are needed</th>
<th>McNemar χ²</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
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<td>56.8 (53.4-60.3)</td>
<td>80.3</td>
</tr>
<tr>
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<td>214</td>
<td>36</td>
<td>22.1 (19.4-25.0)</td>
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<tr>
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<td>26</td>
<td>0</td>
<td>7.6 (0.9-10.2)</td>
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<tr>
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<td>2</td>
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<td>0.4 (0.0-0.8)</td>
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<tr>
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<td>3</td>
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<tr>
<td>Breast cancer screening (n = 297)</td>
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<td></td>
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<tr>
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<td>1</td>
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* Data presented is weighted.
1 Frequent screeners.

Table 3

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<th>Sociodemographic correlates of willingness to receive lifestyle advice at cervical, breast, and FS screening settings (adjusted logistic regression models)</th>
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<tr>
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</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Gender</td>
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<td>Female</td>
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<td>Non-white</td>
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<td>Less than 12 years</td>
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<td>12+ years</td>
</tr>
</tbody>
</table>

* Data presented is weighted.
1 Frequent screeners.

3.4. Impact of information provision on screening uptake

Across the three cancer screening programmes, the majority indicated the provision of lifestyle advice around the time of screening would not affect their willingness to attend (cervical 65.9%, n = 414; breast 65.6%, n = 218; FS 70.4%, n = 217) (Fig. 1). Some participants stated the provision of lifestyle advice would make them more willing to attend cervical 31.2%, n = 202; breast 34.4%, n = 128; FS 20.8%, n = 64. However, for each of the screening programmes, a small minority of people felt the provision of advice would make them less willing to participate in future cancer screening (cervical 4.9%, n = 32; breast 7.9%, n = 26; FS 6.8%, n = 27).

3.5. Preferred timing of lifestyle advice at cancer screening

Most participants who were willing to receive lifestyle advice preferred this advice to be delivered at the screening appointment itself (cervical 68.4%, n = 593; breast 72.6%, n = 214; and FS screening 66.6%, n = 197, followed by the screening results (cervical 21.2%, n = 107; breast 18.9%, n = 56; FS 17.4%, n = 42). Few participants wanted advice 2-4 weeks after attending screening (cervical 6.6%, n = 32; breast 6.9%, n = 20; FS 9.7%, n = 23); 1-2 months after attending (cervical 1.6%, n = 8; breast 1.8%, n = 3; FS 1.5%, n = 4), or more than three months after attending (cervical 0.9%, n = 4; breast 0.9%, n = 1; FS 1.1%, n = 3).

4. Discussion

In this large, population-based sample of English adults, the majority of people intending to attend NHS cancer screening programmes were willing to receive lifestyle advice, even if further investigations were required. For cervical screening, a greater proportion of participants were willing to receive advice when respondents considered it as part of a scenario where their results required further investigations.

(Continued)
This effect was not observed for the breast and bowel screening samples, perhaps due to smaller sample sizes within these screening programmes. As a result, the proportion of people indicating they may be put off attending future screening appointments, suggesting screening uptake should be carefully monitored if lifestyle advice were routinely implemented. Among people willing to receive lifestyle advice, there was a strong preference for information to be delivered at the screening appointment.

The high proportion of people willing to receive lifestyle advice at the cervical screening observed within our study (77.6%) is encouraging and comparable to previous findings (Wilber et al., 2007). It is unknown whether willingness to receive advice would remain high in real life screening settings, and whether receipt of advice would result in behaviour change. Trials conducted within breast and bowel screening settings support around half of attendees (49% and 48% respectively) are interested in participating in interventions focused on topics such as physical activity, weight loss, and alcohol consumption (Richardson et al., 2014c; Anderson et al., 2014d). Retention of participants enrolled in these interventions appears to be high (93% and 81% respectively), suggesting it is feasible to deliver interventions within screening settings.

We identified sociodemographic factors associated with willingness to receive lifestyle advice at FS and cervical screening. For FS, women were more likely to express willingness to receive lifestyle advice compared with men. This is in line with previous research suggesting men are less likely to engage in health-promoting behaviours than women (Courneya, 2009). Almost 90% of women were interested in lifestyle advice at FS, which may be higher than for cervical screening and should be confirmed in other samples. Education and ethnicity were associated with willingness to receive lifestyle advice at cervical screening. Higher education increased willingness to receive advice. The link between education and health behaviour is well established (Cutler and Lleras-Muney, 2010; Pampel et al., 2016). Except for alcohol consumption, unhealthy behaviours are more prevalent among populations of lower socioeconomic status (NSH, 2011). Within our sample, non-white women intending to attend cervical screening were more likely to be willing to receive advice than white women. However, previous research has found ethnic minority women less likely to participate in screening (Kaiser et al., 2009). Only a small proportion of our sample were non-white, therefore these results need to be interpreted cautiously and replicated in more ethnically diverse samples. Education and ethnicity were not associated with willingness to receive lifestyle advice at breast or bowel cancer screening, which may be a result of smaller sample sizes for these scenarios.

A sensitivity analysis reported in Supplementary File 1 explored the potential impact of current lifestyle advice on interest in lifestyle advice within the three scenarios. No associations were identified, however these analyses were limited by sample size due to missing data. A paper exploring interest in specific lifestyle advice topics (weight, physical activity, diet, smoking and alcohol consumption) found varying levels of interest in the different topics among people intending to attend cancer screening (Gusano et al., 2018). Within that sample, specific health behaviours were associated with interest in advice about the relevant lifestyle topic (e.g. those who were not physically active were more interested in receiving physical activity advice).

A small proportion of our sample felt that receipt of lifestyle advice around the time of screening would deter their future screening attendance. At a low level population level this could result in large numbers of people not receiving cancer screening. In 2015-2016, around 3 million women were tested as part of the NHS cervical screening programme (Public Health England, 2016b). Within our sample, 3% of people reported lifestyle advice would make them less likely to attend cervical screening. This could equate to approximately 150,000 fewer women attending cervical screening. The proportion of people who indicated they would be deterred from attending cancer screening was small so it was not possible to explore sociodemographic associations. Future research should aim to confirm whether the provision of lifestyle advice at screening will exacerbate inequalities in screening uptake. If the provision of lifestyle advice is to be implemented alongside cancer screening, interventions must be designed to minimize the proportion of people deterred from attending screening. This would need to be balanced against the health benefits of any intervention offsetting the harm from any decrease in uptake.

Most participants indicated they would like to receive lifestyle advice at the screening appointment itself. Other research suggests the timing of interventions delivered in the context of cancer screening is important (Middlehurst et al., 1999). It has also been reported that people attending screening would prefer advice to be given by an expert, such as a health professional (Bither et al., 2007). This is in line with previous conceptualisations of the teachable moment as potentially reliant on interactions between patients and clinicians (Lauren and Hoeller, 2009). Future work should, therefore, investigate how practical it would be to deliver lifestyle advice within population cancer screening services, who would be best placed to deliver this advice, and how to
join this up with patient preferences.

This research has limitations. It was not possible to obtain information about people who declined to participate in the survey. There may be differences between responders and non-responders. The proportion of people intending to attend screening, across the modalities, was higher than actual uptake rates. High cancer screening intentions are not unusual and overestimation of intention to perform a behaviour is known in the intention-behaviour gap (Sherman, 2002). Within our sample, intention to attend FS was 57%, which is in line with intention rates reported in other English samples (Booth et al., 2008). However, actual FS uptake in England is around half of this figure (McGregor et al., 2016). Non-attenders were likely underestimated making it difficult to draw conclusions about the effect of the provision of lifestyle advice on people who will and will not attend screening. Additionally, whilst sociodemographic differences have been reported consistently for screening uptake, these differences may not be found when looking at screening intention (Booth et al., 2008). Therefore, this research may not accurately reflect sociodemographic differences in intentions or desire for lifestyle advice.

A further limitation is that this study was based on hypothetical scenarios around English cancer screening programmes. English cancer screening programmes are likely to differ from those offered in other countries; therefore these findings may not generalise to other populations. Scenarios presented in this research included attending cancer screening, receiving an abnormal screening result, and receiving lifestyle advice alongside screening. Hypothetical scenarios are likely to differ from appraisals of information delivered in a real-life screening setting. This may be a particular issue for FS screening, as this is a relatively new screening programme, which in the sample would have been limited to participate in yet. Some participants will have been exposed to guidance relating to previous one screening programme, which may impact responses. This effect is difficult to determine because the number of programmes a person is eligible for is context-specific. However, this is supported by the choice of wording of the measures used. We used education level as a proxy of SES, which may not best reflect a person’s socioeconomic position. The use of dichotomised educational and ethnicity variables also impact the interpretation of results. For example, we dichotomised education based on whether someone had attained education at degree level or above, which may have masked differences between groups educated below degree level. The wording of the question may also have influenced responses. We used diet and physical activity as examples of lifestyle advice when asking about intention. Different examples such as smoking cessation or exercise may have prompted a different response. Another limitation is that participants were only asked about their willingness to receive advice at breast, cervical and FS screening. Although intention in receiving advice was high across all three, it is not clear whether willingness to receive advice would be just as high in other settings, such as the workplace (Galb and Lancaster, 2011). Finally, willingness to receive lifestyle advice at cancer screening may not translate into actual behaviour change. Further research is needed to understand adherence to lifestyle advice following its dissemination in a cancer screening setting, and to establish whether offering advice in this context is any more effective than giving it at other times.

5. Conclusion

This study was the first to investigate interest in lifestyle advice across three English cancer screening programmes. Interest was high regardless of the outcome of a person’s screening result. However, our results suggest a minority who would otherwise attend screening might be put off if lifestyle advice were offered. Future research should investigate the feasibility of providing lifestyle advice alongside cancer screening, and how best to deliver effective cancer risk reduction advice without compromising screening attendance.

Financial support

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Conflicts of interest

The authors report no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpneumo.2018.12.005.

References


Appendix E. Publication: Determinants of willingness to receive healthy lifestyle advice in the context of cancer screening

## Determinants of willingness to receive healthy lifestyle advice in the context of cancer screening

Claire Steven, Charlotte Witten, Samuel G. Smith, Jo Walker and Rebecca J. Boekan

### BACKGROUND

Providing lifestyle advice at cancer screening may help reduce the cancer burden attributable to health-related behaviour. We examined determinants of willingness to receive advice about several behavioural cancer risk factors.

### METHODS

A population-based sample of English adults eligible for cancer screening (n = 1222) completed items on willingness to receive lifestyle advice. Sociodemographic, psychological (risk perceptions, cancer risk factor awareness) and behavioural factors were used to predict interest in advice about diet, weight, physical activity, smoking and alcohol consumption.

### RESULTS

Two thirds (62-67%) reported interest in advice about diet, weight, and physical activity. 17% were willing to receive advice on smoking, and 32% about alcohol consumption. Willingness to receive advice was higher in those not adhering to guidelines for weight, physical activity, smoking and alcohol consumption (all p < 0.01). Non-White ethnicity was associated with interest in advice about diet, physical activity and smoking (all p < 0.01). Willingness to receive advice about diet, weight, physical activity and alcohol consumption increased with greater recognition of cancer risk factors (all p < 0.01).

### CONCLUSIONS

Willingness to receive lifestyle advice at cancer screening was high, suggesting this context may provide an opportunity to support behaviour change. Increasing awareness of cancer risk factors may facilitate interest in lifestyle advice.

### INTRODUCTION

It is estimated that exposure to lifestyle and environmental risk factors, such as smoking, dietary factors and overweight account for 44% of cancers. The importance of behavioural risk factors for cancer is recognised in cancer strategy documents. However, a large proportion of English adults are at increased risk of developing cancer as they fail to meet current health behaviour recommendations.

The cancer screening context could provide teachable moments for the delivery of behaviour change advice and interventions. Delivering behaviour change advice within existing health care services is consistent with government policy to "Make Every Contact Count". Lifestyle advice is not routinely offered alongside cancer screening, but this setting could provide an opportunity to reach a large number of people in both primary and secondary care. We have previously shown that three quarters of people intending to attend English breast, cervical and bowel screening programmes would be in favour of receiving lifestyle advice around the time of cancer screening, even if they received an abnormal result (ES, CV, SGS, MV & JR; under review). Interventions delivered at the time of breast and bowel cancer screening have reported adequate uptake and positive health behaviour change. One concern about delivering lifestyle advice in the cancer screening context is the potential negative effect it may have on screening uptake; 6-9% reported advice would be a deterrent in our previous study (ES, CV, SGS, MV & JR; under review). Understanding the sociodemographic, psychological and behavioural determinants of interest in healthy lifestyle advice at cancer screening may aid the development of effective interventions which minimise negative effects on screening uptake.

There is sociodemographic variation in the uptake of English cancer screening programmes. The uptake of Flexible Sigmoidoscopy is lower (39%) in the most deprived areas (53%). In addition, ethnic minority groups are less likely to participate in cancer screening than white populations. Similar sociodemographic variation has been observed for other cancer related health behaviours including smoking and diet. Less is known about whether there is also variation in receptivity to different topics of lifestyle advice at cancer screening. Some research has found that interest in advice at breast screening was higher in women who were older, less educated and overweight. However, other research has found that receptivity to advice at cervical screening may be greater among more educated and non-White populations (ES, CV, SGS, MV & JR; under review). One lifestyle intervention evaluated within a bowel screening setting reported higher levels of recruitment and retention from deprived groups, and found no differences in outcomes between more and less deprived groups.

Risk perceptions are commonplace in theories attempting to understand and change health behaviour. Risk perceptions are a key component of the Teachable Moment Heuristic. The model states that for behaviour change to occur following the teachable moment, perceived risk must increase. It has also been suggested that to capitalise on the teachable moment, people must be aware of the

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risk factors for cancer and how they relate to their own behaviour. A survey of British adults found variation in the recognition of different risk factors for cancer. Recognition was high for smoking (96%), but lower for other important risk factors such as obesity (54%) and fruit and vegetable consumption (48%). Awareness of the link between lifestyle and cancer could be a determinant of interest in lifestyle advice as cancer screening. Furthermore, receptivity to lifestyle advice may increase if people are given convincing evidence showing a link between lifestyle and cancer-related outcomes.

This research aimed to identify sociodemographic, psychological (risk perception, cancer risk factor awareness) and behavioural predictors of interest in each of the lifestyle advice topics.

METHODS
Design
Cross-sectional population-representative data were collected as part of the Attitudes, Behaviour and Cancer UK Survey (ABCUS). This survey aims to explore the determinants of early detection and prevention behaviours related to cancer. Data were collected as part of an omnibus survey, conducted by market research company Taylor Nelson Sofres (TNS) in April and May 2010 using home-based computer-assisted personal interviews.

Participants
A nationally representative sample of 2048 English adults (aged 18-76) were recruited using stratified random location sampling, based on 2011 Census data and Postcode Address File data. Cases were set for gender, working status and status of children in the home. This research included a subsample of men and women currently eligible to participate in breast, bowel or cervical screening, and people approaching the age of eligibility. We included people approaching the age of eligibility for cancer screening for two reasons. Firstly, if lifestyle advice is routinely offered alongside cancer screening it is important to sample potential future attendees as well as people currently eligible to attend. Secondly, the narrow age range of this group provides increased statistical power and delays in the roll out of this screening programme would have limited our sample. Participants were included in the analysis if they intended to take part in at least one of the cancer screening programmes. Taking into account recent changes to cancer screening programmes, people classified as currently eligible for cancer screening were women aged 25-70, and men aged 60-70, and people classified as approaching eligibility were women aged 18-24 and men aged 45-59. Three cancer screening programmes operate in England. Women are invited to attend cervical screening between the ages of 25-64, and breast screening between the ages of 50-70.

Measures
Sociodemographic variables. Participants’ age, gender, ethnicity, and educational attainment (as a measure of socioeconomic status) were recorded. For analyses, ethnicity was categorised into ‘White’ and ‘non-White’. Educational attainment was categorised into ‘degree level or above’ and ‘education below degree level’, based on the item ‘what is the highest level of educational qualification you have obtained?’.

Cancer screening intention. Intention to participate in cancer screening was assessed separately for each of the four cancer screening programmes (breast, cervical, FOBT, PSA, e.g. ‘will you go for breast screening when, or next time you are invited?’). Four response options were offered (Yes, Definitely; Yes, Probably; No, probably not; No, definitely not), which were dichotomised into yes and no. A composite item was created which identified participants intending to take part in at least one of the screening programmes in the future.

Knowledge of cancer risk factors. Knowledge of cancer risk factors was assessed using an 11-item scale from the Cancer Research UK Cancer Awareness Measure (CRUK CAM). Participants were presented with 11 risk factors for cancer including smoking, exposure to another person’s cigarette smoke, alcohol consumption, fruit and vegetable consumption, red and processed meat consumption, overweight, childhood sunburn, age over 50 years, having a close relative with cancer, infection with HPV, and physical inactivity. Five response options were provided, which were categorised into correct (agree / strongly agree) or incorrect (strongly disagree / disagree / not sure). For each participant, the number of risk factors that they correctly identified was calculated giving each participant a score out of 11.

Comparative cancer risk. Comparative cancer risk perception was assessed using the item ‘How would you rate your chances of getting cancer, compared with other men / women your age?’, adapted from existing measures. Five response options were categorised into lower (much lower / a little lower), the same (about the same), and higher (a little higher / much higher).

Current health behaviours. Fruit and vegetable consumption was assessed using two items. Over the past month, how many portions of fruit / vegetables did you usually eat per day? Responses options were: less than 1 a day, 1-2 per day, 2-3 per day, 4-6 per day, 7 or more per day. Values =1 or more per day for each item were added together to create a composite measure of fruit and vegetable consumption. Participants consuming five or more portions of fruit and vegetables per day were classified as meeting guidelines. Body Mass Index (BMI) (kg/m²) was calculated from self-reported height and weight. Imausible BMI data were excluded (BMI < 14 or > 50). BMI was dichotomised to <25 (overweight) vs ≥25 (not overweight). A single item was used to assess levels of physical activity. In the past week on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? Participants taking part in 30 min of physical activity on five or more days per week were classified as meeting guidelines. Smoking status was assessed using a single item. Do you smoke at all nowadays? Participants were categorised as smokers (Yes, I smoke daily; Yes, I smoke occasionally or non-smokers (No, never). Participants who used to smoke occasionally or never had a smoking history. A single item was used to assess alcohol consumption. Alcohol consumption was assessed using a single item. Did you drink alcohol in the last year? Participants consuming 14 units or more per week were classified as meeting guidelines for alcohol consumption.

Willingness to receive different types of lifestyle advice at cancer screening. The following questions were asked of participants intending to take part in at least one screening programme in the...
Table 1. Sample characteristics

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<td>364</td>
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<tr>
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<tr>
<td>Fruit and vegetable consumption</td>
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Table 2. Interest in different types of lifestyle advice

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<th></th>
<th>n</th>
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<tr>
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<td>114</td>
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<td><strong>Physical activity</strong></td>
<td>(n = 1181)</td>
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<tr>
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<td>104</td>
<td>8.7</td>
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<td><strong>Alcohol consumption (n = 1182)</strong></td>
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<tr>
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<td>392</td>
<td>32.2</td>
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**RESULTS**

Sample characteristics

Of the 2018 adults included in the NHGIS, 1221 were included in this analysis (Table 1). The mean age of the sample was 46.9 (SD 15.7). Three quarters (75.8%, n = 930) were female, which reflects the inclusion criteria based on screening eligibility. The majority (87.9%, n = 1707) were White. One third of the sample (33.1%, n = 375) were educated to degree level or above. Three quarters of the sample (75.1%, n = 917) were currently eligible to participate in at least one cancer screening programme.

The majority of the sample did not smoke (64.9%, n = 1028), and consumed fewer than 14 alcohol units per week (68.3%, n = 1058). Half of the sample had a BMI of 25 or lower (48.8%, n = 495). Around one third reported meeting guidelines for fruit and vegetable consumption (37.2%, n = 452) and physical activity (39.6%, n = 368). Most of the sample reported their risk of developing cancer to be the same as others of their age and sex (98.5%, n = 1191). On average, people were able to recognise 5.9 (SD 2.7) of the 11 cancer risk factors. For unweighted sample characteristics see Table 1.

Future cancer screening was included in the NHGIS, 1221 were included in this analysis (Table 1). The mean age of the sample was 46.9 (SD 15.7). Three quarters (75.8%, n = 930) were female, which reflects the inclusion criteria based on screening eligibility. The majority (87.9%, n = 1707) were White. One third of the sample (33.1%, n = 375) were educated to degree level or above. Three quarters of the sample (75.1%, n = 917) were currently eligible to participate in at least one cancer screening programme.

The majority of the sample did not smoke (64.9%, n = 1028), and consumed fewer than 14 alcohol units per week (68.3%, n = 1058). Half of the sample had a BMI of 25 or lower (48.8%, n = 495). Around one third reported meeting guidelines for fruit and vegetable consumption (37.2%, n = 452) and physical activity (39.6%, n = 368). Most of the sample reported their risk of developing cancer to be the same as others of their age and sex (98.5%, n = 1191). On average, people were able to recognise 5.9 (SD 2.7) of the 11 cancer risk factors. For unweighted sample characteristics see Table 1.
Table 3. Demographic, psychological and behavioural predictors of interest in advice about diet, weight, physical activity, smoking, and alcohol consumption at cancer screening (adjusted logistic regression models)

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<th>Predictor</th>
<th>Diet (n = 1096)</th>
<th>Weight (n = 903)</th>
<th>Physical activity (n = 1081)</th>
<th>Smoking (n = 1078)</th>
<th>Alcohol (n = 1096)</th>
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<tr>
<td>Met guidelines for behaviour in question</td>
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<td>Number of cancer risk factors recognised</td>
<td>1.00 (1.03-1.14)</td>
<td>1.01 (1.01-1.17)</td>
<td>1.02 (1.03-1.12)</td>
<td>1.09 (1.01-1.17)</td>
<td>0.018 (1.28-1.97)</td>
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</table>

Fig. 1: Proportion of participants willing to receive each type of lifestyle advice, by adherence to behavioural guidelines

Interest in lifestyle advice at cancer screening
Two thirds of participants were interested in receiving advice about diet (67.3%, n = 727) and physical activity (61.5%, n = 727) during future cancer screening appointments (Table 2). Around one in five people were interested in receiving advice about smoking cessation (16.9%, n = 196) and a third of the sample were interested in information about alcohol consumption (31.6%, n = 374).

Current behaviour and interest in lifestyle advice at cancer screening
Participants whose health behaviour fell short of recommendations were more likely to be interested in advice about weight, physical activity, smoking and alcohol consumption (Table 3; Fig. 1). Three quarters of participants in the overweight category expressed an interest in advice about keeping a healthy weight (74.6%) compared with 59.0% of participants classified as not...
overweight (OR 2.52, 95% CI 1.80–3.42, p < 0.001) (Fig. 1). Interest in advice about physical activity was expressed by 63.8% of people not taking part in 30 minutes of moderate activity five times per week, compared with 52.9% of people who were already physically active (OR 1.54, 95% CI 1.17–2.03, p = 0.002). Smokers had greater odds of interest in smoking cessation advice (9.77) compared with non-smokers (9.15, OR 1.02, 95% CI 1.00–2.46, p = 0.001). Participants who exceeded 14 alcohol units per week were more likely to report interest in advice about alcohol consumption (2.0) when compared with participants meeting alcohol consumption guidelines (2.9%; OR 2.35, 95% CI 1.50–3.53, p = 0.001). Analyses were repeated excluding those participants who felt the advice would not be applicable to them, and results were broadly unchanged. However, for interest in PA and alcohol, meeting the guidelines was not as strongly associated, and for interest in dietary advice, those who perceived themselves to be at lower risk were more likely to be interested in advice.

Sociodemographic determinants of interest in lifestyle advice at cancer screening

The odds of reporting interest in advice about alcohol decreased with increasing age (OR 0.99, 95% CI 0.97–1.00, p = 0.007). Non-White participants were more likely to be interested in dietary and physical activity advice. Interest in dietary advice was expressed by 80.5% of non-White participants, compared with 65.5% of White participants (OR 2.10, 95% CI 1.27–3.45, p = 0.004). Similarly, 78.9% of non-White participants expressed interest in advice about physical activity compared with 59.2% of White participants (OR 2.44, 95% CI 1.42–4.16, p = 0.001). There were no associations between gender or education and interest in any of the five topics of advice.

Psychological determinants of interest in lifestyle advice at cancer screening

Cancer risk factor awareness was positively associated with interest in advice on all topics except for alcohol consumption and smoking. For each additional cancer risk factor recognised, the odds of being willing to receive advice about diet (OR 1.09, 95% CI 1.05–1.14, p = 0.001), weight (OR 1.11, 95% CI 1.05–1.17, p = 0.001), physical activity (OR 1.07, 95% CI 1.02–1.12, p = 0.008), and alcohol consumption (OR 1.12, 95% CI 1.05–1.18, p = 0.001) increased. We also explored whether knowledge of individual risk factors was associated with interest in information about their corresponding topics of advice. People who recognised low fruit and vegetable consumption as a risk factor for cancer were more likely to want dietary advice at cancer screening (OR 1.48, 95% CI 1.19–1.86, p = 0.009). Recognition of alcohol consumption as a risk factor for cancer was associated with interest in advice about alcohol consumption (OR 1.70, 95% CI 1.30–2.22, p = 0.001). Recognition of overweight (OR 1.12, 95% CI 0.84–1.51, p = 0.446), low physical activity (OR 1.24, 95% CI 0.95–1.62, p = 0.118), and smoking (OR 1.19, 95% CI 0.70–2.23, p = 0.390) were not associated with interest in their respective topics of advice. Comparative cancer risk perceptions were not strongly associated with interest in any of the topics of lifestyle advice.

DISCUSSION

This cross-sectional population-based survey of English adults found that people intending to participate in cancer screening are willing to receive advice about a range of behavioural cancer risk factors during the screening process. For most topics of advice, people not meeting health behaviour guidelines were more likely to be interested, in addition, non-White ethnicity, younger age, and greater cancer risk factor awareness were associated with interest in some topics of advice.

Providing lifestyle advice at cancer screening could be an effective strategy to promote behaviour change. However, if unacceptable to some people, the provision of lifestyle advice at cancer screening could reduce screening uptake, or increase socioeconomic inequalities in screening participation (CS, CV, SGS, JW & JWB, under review). One concern about delivering lifestyle advice at cancer screening is that screening non-attendees will not be reached.15 This is a problem because people from more deprived areas, non-White populations, and people with poorer health behaviours may be less likely to attend cancer screening.16 It was therefore encouraging that within our sample non-White participants who intended to take part in cancer screening in the future were more likely to report interest in information about diet, physical activity and smoking cessation. This may suggest that non-White participants who do participate in cancer screening may be particularly open to offers of other cancer prevention services and advice. Additionally, non-White participants may see cancer screening as an opportunity to address information needs that are not currently being met elsewhere. Interest in advice about alcohol consumption reduced with increasing age.17 There were no associations between gender, educational status and interest in lifestyle advice. However, further research is needed to confirm this within other samples.

Current health behaviour was associated with interest in advice about physical activity, weight, smoking and alcohol consumption at cancer screening. This suggests that a tailored approach to intervention design, which takes current behaviour into consideration, may be best in this setting. Tailored advice has been delivered within the context of colorectal cancer screening, and has been successful at increasing reported fruit and vegetable consumption but did not increase physical activity or reduce alcohol consumption.18 Tailoring may be particularly beneficial for less prevalent behaviours, such as smoking and excessive alcohol consumption.

Previous research suggests that health care professionals may be reluctant to deliver advice about topics such as weight, fearing that this advice may cause distress to patients.19 Reassuringly, three quarters of overweight participants in our sample were willing to receive advice about weight as part of cancer screening services. This is supported by the finding that advice about weight in a primary care setting is considered appropriate and helpful by the majority of patients, and that interest in diet and weight advice at breast screening is greater among overweight women.20,21

Cancer risk factor awareness and risk perceptions were explored as potential determinants of interest in advice at cancer screening. Risk perceptions were not strongly associated with interest in any of the topics of advice. However, a single item measure of comparative cancer risk was used.22 Further research is needed to understand whether other aspects of risk, such as affective or experiential risk perceptions are associated with interest in lifestyle advice at cancer screening.23 Risk factor awareness was positively associated with willingness to receive advice about diet, weight, physical activity, and alcohol consumption. Previous research has highlighted the importance of providing convincing evidence about the link between lifestyle and cancer risk within cancer screening settings.24 This suggests that interventions delivered during the cancer screening process may benefit from increasing awareness of cancer risk factors.

This research has limitations. As stated in previous research carried out with this sample, participants were not recruited from screening settings so questions relating to the delivery of lifestyle advice at cancer screening were hypothetical (CS, CV, SGS, JW & JWB, under review). The well-documented intention-behaviour gap means it is likely that a number of people intending to participate in cancer screening will not take up the offer when invited,25 and willingness to receive lifestyle advice...
may differ between people who intend to participate in screening, and people who actually participate. Interest in lifestyle advice is high across breast, bowel and cervical screening programmes (CS, SG, W & JB, under review). However, in this research participants were asked to rate their interest in lifestyle advice at cancer screening in general, not for each cancer screening programme individually. Therefore it is not known whether interest in different topics of advice may vary between screening modalities. A further limitation to this research is the dichotomisation of responses to items assessing interest in each of the topics of advice. This involved grouping participants who answered “not at all interested” and “not applicable” and reanalysed the data excluding participants who responded “not applicable” and results were broadly unchanged.

Our sample appear to be more health conscious than would be expected in the general population. For example, around half of our sample had a BMI > 25, compared with 95% of English adults in the general population.10 The health behaviours of screening attendees have been found to differ from non-attendees, which may also be the case for the screening intentions within our sample.11 In addition, survey respondents may also be healthier than the general population.12 However, measures of health behaviour used in this study may also impact the findings of this research. All health behaviour measures were self-reported, which may be subject to a number of biases.13 For example, we used fruit and vegetable consumption as a proxy of diet, however the accuracy of self-reported dietary data has been questioned.14 These self-reported measures were then used to gauge whether people were following guidelines. To classify people as meeting guidelines for alcohol consumption we used a cut off of 14 units, however it is recognised that any alcohol consumption can increase cardiovascular risk.15 With respect to receiving advice about alcohol consumption may vary depending on the reliance of the recommendation used.

In conclusion, the majority of people who intend to participate in cancer screening would be willing to receive advice about common cancer risk factors at this time. Advice appears to be acceptable to people who do not meet recommendations for health behaviours, and to non-white participants. Increasing cancer risk factor awareness and tailoring advice to current behaviours may provide an important basis for the development of interventions within the cancer screening setting.

AUTHOR CONTRIBUTIONS
All authors were involved in the design of the manuscript, analysis and interpretation of results, and in preparing the manuscript for submission.

ADDITIONAL INFORMATION
Competing interests: The authors declare no competing interests.

Availability of data and materials: Data will be made available to other researchers after the acceptance for publication of the main findings of the ARCABU survey. Data requests will be assessed on a case-by-case basis. Users will be required to complete a data sharing agreement.

Consent for publication: Included patients had previously signed written informed consent regarding the anonymous publication of their clinicopathological data for the translational research purposes.

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Ethical approval: Ethical approval was granted by the UCL Research Ethics Committee B (F177/1602). Consent to participate was sought by market research company Taylor Nelson Sofres (TNS).

REFERENCES
### Appendix F. Items from the Attitudes, Behaviour and Cancer UK survey: Wave 4

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*Health related variables*
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<tr>
<td></td>
<td>3. About the same</td>
</tr>
<tr>
<td></td>
<td>4. A little higher</td>
</tr>
<tr>
<td></td>
<td>5. Much higher</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alcohol consumption</th>
<th>Q1. In a typical week, on how many days do you have a drink containing alcohol?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. 1</td>
</tr>
<tr>
<td></td>
<td>2. 2</td>
</tr>
<tr>
<td></td>
<td>3. 3</td>
</tr>
<tr>
<td></td>
<td>4. 4</td>
</tr>
<tr>
<td></td>
<td>5. 5</td>
</tr>
<tr>
<td></td>
<td>6. 6</td>
</tr>
<tr>
<td></td>
<td>7. 7</td>
</tr>
<tr>
<td></td>
<td>8. 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Q2. How many units of alcohol do you drink on a typical day when you are drinking? (Image of AUDIT-C unit guidance shown)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. 1</td>
</tr>
<tr>
<td></td>
<td>2. 2</td>
</tr>
<tr>
<td></td>
<td>3. 3</td>
</tr>
<tr>
<td></td>
<td>4. 4</td>
</tr>
<tr>
<td></td>
<td>5. 5</td>
</tr>
<tr>
<td></td>
<td>6. 6</td>
</tr>
</tbody>
</table>
Physical activity

In the past week on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job.

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. None

Fruit and vegetable consumption

Q1. Over the past month, how many portions of fruit did you usually eat? Include fruit eaten at meal times or as a snack.

(If participant needs guidance on what makes one portion of fruit, please read: Examples of a serving are 1 apple or banana, a large slice of...
melon, 2 plums or satsumas, a small bowl of grapes, 2 tablespoons of tinned fruit, or \( \frac{1}{2} \) tablespoon of dried fruit)
1. Less than 1 per week  
2. 1 per week  
3. 2-3 per week  
4. 4-6 per week  
5. 1 per day  
6. 2 per day  
7. 3 per day  
8. 4 per day  
9. 5 or more per day

Q2. Over the past month, how many portions of vegetables did you usually eat? Include vegetables eaten at meal times or as a snack.  
(If participant needs guidance on what makes one portion of vegetables, please read: Examples of a serving are 2 heaped tablespoons of broccoli or carrots, 3 tablespoons of sweetcorn or peas or a bowl of salad. Please do not include potatoes, sweet potatoes, or plantains as a vegetable serving.)
1. Less than 1 per week  
2. 1 per week  
3. 2-3 per week  
4. 4-6 per week  
5. 1 per day  
6. 2 per day  
7. 3 per day  
8. 4 per day  
9. 5 or more per day

<table>
<thead>
<tr>
<th>Smoking</th>
<th>Do you smoke at all these days? Either cigarettes, including hand-rolled ones, pipes, or cigars?</th>
</tr>
</thead>
</table>
|         | 1. Yes, I smoke daily  
|         | 2. Yes, I smoke occasionally  
|         | 3. Not now, but I used to smoke daily  
|         | 4. Not now, but I used to smoke occasionally  
|         | 5. I’ve tried smoking in the past, but I have never been a smoker  
|         | 6. I have never smoked  

<p>| Weight | What is your weight? If unsure, give your best estimate. Please give your weight in st and lbs, OR in kgs, OR in lbs only |</p>
<table>
<thead>
<tr>
<th>BOX 1: ___st ___lbs (MAX st=50, MAX lbs=13)</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOX 2: ___lbs (MAX 700)</td>
<td>OR</td>
</tr>
<tr>
<td>Box 3: ___kg (MAX 400)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height</th>
<th>What is your height? Please give your height in ft and inches, OR in cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOX 1 ___ft ___inches (MIN 4ft, MAX 7ft)</td>
<td>OR</td>
</tr>
<tr>
<td>BOX 2 ___ cm (MIN 120, MAX 210)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cancer risk factor awareness</th>
<th>How much do you agree that each of these can increase a person’s chance of developing cancer?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response options</td>
<td>Strongly agree, Agree, Not sure, Disagree, Strongly disagree</td>
</tr>
<tr>
<td>1. Having a close relative with cancer</td>
<td></td>
</tr>
<tr>
<td>2. Getting sunburnt more than once as a child</td>
<td></td>
</tr>
<tr>
<td>3. Exposure to another person’s cigarette smoke</td>
<td></td>
</tr>
<tr>
<td>4. Doing less than 30 minutes of moderate physical activity 5 times a week</td>
<td></td>
</tr>
<tr>
<td>5. Being over 70 years old</td>
<td></td>
</tr>
<tr>
<td>6. Infection with HPV (Human Papillomavirus)</td>
<td></td>
</tr>
<tr>
<td>7. Smoking any cigarettes at all</td>
<td></td>
</tr>
<tr>
<td>8. Eating red or processed meat once a day or more</td>
<td></td>
</tr>
<tr>
<td>9. Eating less than 5 portions of fruit and vegetables a day</td>
<td></td>
</tr>
<tr>
<td>10. Drinking more than 1 unit of alcohol a day</td>
<td></td>
</tr>
<tr>
<td>11. Being overweight (BMI over 25)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intention to attend cancer screening (asked separately for breast / bowel / cervical screening)</th>
<th>Will you go for breast / bowel scope / cervical screening when / next time you are invited?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Yes, definitely</td>
<td></td>
</tr>
<tr>
<td>2. Yes, probably</td>
<td></td>
</tr>
<tr>
<td>3. No, probably not</td>
<td></td>
</tr>
<tr>
<td>4. No, definitely not</td>
<td></td>
</tr>
</tbody>
</table>
| Willingness to received lifestyle advice at screening. (asked separately for breast / bowel / cervical screening) | Would you be willing to receive advice about making healthy lifestyle changes (for example, diet or physical activity) as part of the breast / bowel scope / cervical screening programme?  
1. Yes, definitely  
2. Yes, probably  
3. No, probably not  
4. No, definitely not  
5. Not sure |
|---|
| Effect of advice on willingness to attend screening. (asked separately for breast / bowel / cervical screening) | If you knew you would receive advice about lifestyle as part of the cervical screening programme, would this affect your willingness to attend breast / bowel / cervical screening?  
1. Yes, I would be more willing to attend  
2. Yes, I would be less willing to attend  
3. No, it would not affect my willingness to attend |
| Willingness to receive advice if further investigations are needed. (asked separately for breast / bowel / cervical screening) | Would you be willing to receive lifestyle advice if your screening result suggested you needed to have further investigations?  
1. Yes, definitely  
2. Yes, probably  
3. No, probably not  
4. No, definitely not  
5. Not sure |
| Preferred timing of advice at screening. (asked separately for breast / bowel / cervical screening) | When would you prefer to receive lifestyle advice as part of the breast / bowel / cervical screening programme?  
1. At the same time as the screening appointment  
2. With my screening results (around two weeks after attending screening)  
3. 2-4 weeks after attending screening  
4. 1-3 months after attending screening  
5. More than 3 months after attending screening |
| Interest in different types of lifestyle advice at screening. | At cancer screening / If you were to attend cancer screening in the future, how interested would you be in any information or advice to…  
1. Help you have a healthy diet?  
2. Help you maintain a healthy weight?  
3. Help you increase your physical activity?  
4. Help you stop smoking?  
5. Help you reduce your alcohol consumption? |
<table>
<thead>
<tr>
<th>Response options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all interested / a little interested / somewhat interested / very interested / not applicable.</td>
</tr>
</tbody>
</table>
Appendix G. Publication: Interest in lifestyle advice at lung cancer screening: Determinants and preferences

Claire Stevens*, Samuel G. Smith‡*, Samantha L. Quaife*, Charlotte Vrinten*, Jo Waller†, Rebecca J. Boelen*‡

1 Department of Health Sciences, Leeds Institute of Health Sciences, University of Leeds, Leeds LS2 9NU, UK.

ABSTRACT

Background: Lung cancer screening could be a teachable moment for behaviour change. Little is known about how advice about smoking cessation, or other behavioural and cancer risk factors, would be received in this setting. Methods: Using a population-based survey of 459 English adults (current smokers and recent quitters aged 50–75) we assessed willingness to receive lifestyle advice (about smoking, diet, weight, physical activity, alcohol consumption) at lung screening. Additional items assessed whether advice should be provided following abnormal screening results, the potential impact of advice on screening uptake, and perceived timing of advice. Results: Overall, 67% (n = 232) of participants were willing to receive lifestyle advice at lung screening. A greater proportion of participants were willing to receive advice in a scenario where results required further investigation (69% vs. 60%). However, 14% indicated they would be less willing to attend lung screening. Non-white ethnicity and greater cancer risk factor awareness were associated with willingness to receive advice (p < 0.05). 54% of smokers (35%) were willing to receive smoking cessation advice. There was also interest in advice about diet (47%), weight (64%), physical activity (32%), and alcohol consumption (17%) among people not meeting current recommendations for these behaviours. There was a preference for advice to be delivered at the screening appointment (39%, n = 100) over other time-points. Conclusions: Lung screening may offer an opportunity to provide advice about behavioural and cancer risk factors. Future work should consider how to deliver effective interventions in this setting to support behaviour change, without affecting screening uptake.

1. Introduction

The European position statement on lung cancer screening recommends low-dose computed tomography for high-risk populations, with smoking cessation advice offered alongside [1]. The prevalence of tobacco smoking ranges from 10 to 30% between European countries [2]. In England, 17% of adults smoke [3]. However, data from lung screening trials suggest smoking prevalence is likely to be higher among lung screening attendees [4–6] within the UK Lung Cancer Screening (CLASH) pilot trial [2]. Of the screening arm were current smokers [3]. Tobacco is the single greatest contributor to cancer burden in the European Union [7]. However, health behaviours related to chronic, and smoking abstinence is more likely to engage in other cancer risk behaviours, including increased alcohol consumption and smoking unhealthy cigarettes [8]. These modifiable behaviours contribute to many non-communicable diseases including cancer, cardiovascular and respiratory diseases, and diabetes [10]. The lung cancer screening population may therefore stand to benefit considerably from a smoking risk factor approach to behaviour change. Combining cancer screening and behaviour change advice could be cost-effective and provide the greatest impact on mortality [11–13], with theaddition of smoking cessation interventions alone estimated to improve the cost-effectiveness of lung screening by 20–45% [14]. Behaviour change interventions delivered within lung cancer screening trials have focused on smoking cessation, with a recent systematic review showing tentative positive support for these implementations [15,16]. To our knowledge, no research has explored the implementation or acceptability of advice about other cancer risk factors at lung cancer screening. It is therefore important to consider the acceptability of advice about multiple risk factors within this context. Most people appear to be willing to receive lifestyle advice about a range of cancer risk factors at breast, bowel and cervical screening.
Encouragingly, those with unhealthy behaviours appear to be more willing to receive advice, as do those who are more aware of risk factors for cancer [19]. However, there is concern that providing lifestyle advice at cancer screening may negatively impact uptake [17]. Lung cancer screening uptake is low, particularly among current smokers and socioeconomically deprived populations [20,21]. It is therefore important to explore preferences for advice during cancer screening, as well as determining the interest in that information to avoid exacerbating socioeconomic inequalities further.

Using a nationally representative sample of English adults and hypothetical lung screening scenarios, this research aimed to estimate the proportion of screening invitees interested in receiving lifestyle advice alongside lung cancer screening. We also aimed to identify determinants of interest in lifestyle advice at lung cancer screening, and people’s preferences for the timing and topics of advice.

2. Methods

2.1. Design

Data were collected using the Smoking Toolkit Study, a monthly cross-sectional survey of smoking trends in England between January–November 2017 total survey n = 11,099 [22]. Face-to-face computer-assisted interviews were conducted by market research agency Ipsos MORI as part of an omnibus survey. Ethical approval was granted by the University College London Research Ethics Committee [REC 15/05/022], and informed consent was obtained prior to each interview.

2.2. Participants

A random birthday sampling was used. Quotas were set for sex, age, working status, and housing tenure to create a nationally representative sample. Participants received questions relating to acceptability of lifestyle advice at a hypothetical lung cancer screening programme based on age and smoking history. Using UK lung Cancer Screening trial criteria, we included adults aged 50–78 years [23]. It was not possible to calculate individuals’ lung cancer risk, so the sample was limited to participants who smoked, or who had quit smoking within the last 5 years. Participants were included in analyses if they stated they would attend lung cancer screening if invited, and were excluded if they had a previous cancer diagnosis.

2.3. Measures

Full measures are reported in Supplementary File 1. Data were collected for four sociodemographic variables: age, gender (male/female), ethnicity (White/Non-White) and educational attainment as a marker of social position (education to degree level or above/education below degree level).

Participants were provided with a brief description of CT lung screening prior to questions relating to lung screening: “A new screening test is being developed to find lung cancer at an early stage. It would use a type of x-ray called a chest CT scan. The scan takes pictures of the lungs which are then checked for the early signs of lung cancer. The screening test would be offered to people who smoke or used to smoke, not people going to their GP with symptoms of lung cancer.”

Intention to attend lung screening was assessed by response to “If your GP invited you to have a lung cancer screening test as part of the NHS lung cancer screening programme, would you take up the offer?” dichotomized into yes (Yes, definitely; Yes, probably) and no (No, probably not; No, definitely not). Lung screening invitees were asked “Would you be willing to receive advice about making healthy lifestyle changes (for example, diet or physical activity) as part of a lung cancer screening programme?” 2.4. Analysis

Descriptive analyses estimated willingness to receive information around the time of screening, the effect of information provision on screening uptake and preferences for information timing and topics. McNemar’s test was used to investigate differences between interest in advice in general, and if results would require further investigation. Corrected Pearson Chi-squared analyses investigated differences in proportions of people willing to receive each topic of advice by current health behaviour. Two adjusted binary logistic regression models were used to identify determinants of interest in advice, and determinants of being put off attending screening if advice were delivered. Weighting were applied to unweighted analyses to account for response bias. Weighting were calculated by Ipsos MORI using gender, age, social grade, region, working status, housing tenure and ethnicity. Analyses were conducted in Stata SE 14.2.

3. Results

3.1. Sample characteristics

Of those interviewed, 665 were current smokers or recent quitters aged 50–75. Participants were excluded from analyses if they had
Table 1

<table>
<thead>
<tr>
<th>Gender</th>
<th>Unweighted (n = 459)</th>
<th>Weighted (x = 459)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>Men</td>
<td>246</td>
<td>226</td>
</tr>
<tr>
<td>Women</td>
<td>213</td>
<td>233</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Gender</th>
<th>OR (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>0.77 (0.52-1.13)</td>
<td>0.183</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Education</th>
<th>OR (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-White</td>
<td>7.0 (1.9-26.4)</td>
<td>0.009</td>
</tr>
</tbody>
</table>

3.3. Impact of lifestyle advice on intention to have lung screening

Most lung screening ineners indicated that the provision of lifestyle advice at screening would make no difference to their decision to attend (63.2%, n = 289), or would make them more willing to attend if lifestyle advice was provided (22.4%, n = 105). However, 13.9% (n = 84) of participants indicated they would be less willing to attend screening if lifestyle advice was provided. When we dichotomised the sample into those who would find lifestyle advice off-putting vs. those who would not, no determinant were found (Table 3).

3.4. Information preferences in lung cancer screening

The preferred settings for the delivery of lifestyle advice at lung cancer screening were as the screening appointment (37.7%, n = 128), with the screening results (30.5%, n = 67), and before the screening appointment (17.2%, n = 59). Few people thought advice should be provided at a later date (2.4 weeks after attending screening) = 7.5%, n = 22; 1-3 months after attending screening = 5.2%, n = 15; more than three months after attending screening = 1.9%, n = 5).

Of the five topics of advice, interest was highest for smoking cessation (41.0%, n = 82), dietary advice (48.4%, n = 89) and physical activity (29.6%, n = 58). One in ten participants (9.5%, n = 52) were interested in advice about alcohol consumption. Interest in advice about smoking, diet, weight and alcohol consumption was associated with adherence to the behaviours in question, with non-adherent people more interested in the relevant advice (Fig. 1).

3.2. Willingness to receive lifestyle advice at lung cancer screening

Two thirds (63.6%, n = 292) were willing to receive lifestyle advice at lung cancer screening. Non-White ethnicity and greater cancer risk factor awareness were associated with greater willingness to receive advice at this time (Table 2). Compared with 63.6% (n = 292) of White participants, 83.0% (n = 26) of non-White participants were willing to receive lifestyle advice at lung cancer screening, although confidence intervals were wide (OR 1.10, 95% CI 1.0-1.2, p = 0.023). In a scenario where screening resulted in further investigations, 83.1% (n = 362) indicated they would be willing to receive lifestyle advice at lung cancer screening. A greater proportion of people were willing to receive advice in this scenario, compared with during lung screening in general (McNemar's χ² = 124.77, p < 0.001).
information close to the screening appointment (before attending, during the appointment or after). It may be necessary to offer information at multiple stages to appeal to different preferences, to reinforce messages and to promote continuity of support for behaviour change. A greater proportion of non-White participants were interested in receiving lifestyle advice if this was tailored to their needs. Increased smoking cessation rates have been observed among lung screening attendees with abnormal results, compared with attendees with normal screening results [38,39]. This suggests interventions may benefit from being tailored to screening result.

There is support for the implementation of smoking cessation interventions within the context of lung cancer screening, and tentative support of the efficacy of these interventions [1,6]. However, research to date has not extended the focus of behavioural interventions at lung screening beyond smoking cessation. Our research suggests lung screening could be an opportunity to deliver lifestyle advice on various topics, including diet, weight and PA. Health behaviour was associated with interest in advice about smoking, alcohol consumption, diet and weight, which suggests a tailored, multiple risk factor approach may be appropriate. Interest in alcohol consumption advice was, however, low within our sample. This is a concern as a clustering of health behaviours means alcohol consumption is higher among smokers than non-smokers, and therefore likely to be higher among lung screening attendees [8,9]. It is important to consider how and when different types of advice could be offered to optimise their acceptability and effectiveness.

This research has limitations. Hypothetical scenarios were used to gauge interest in lifestyle advice among lung cancer screening attendees. An intention-behaviour gap has been observed for other cancer screening programmes [52,53], so it is likely that a proportion of our sample of screening attendees may not participate in lung screening if invited. As lung screening is not currently offered in England, the sample selected for this research may differ from the population invited to participate in lung screening if an organised programme were to be implemented in the future. Our criteria were based on the age-range used in a previous screening trial and smoking history, as it was not possible to calculate lung cancer risk [23]. Therefore, our sample may not represent the sample eligible for an eventual UK lung screening programme. Finally, the measures used within this study may limit our findings. The self-report measures used to assess health behaviour may be subject to response biases [19]. The choice and categorisation of sociodemographic covariates, such as the dichotomisation of ethnicity and the use of educational attainment as a marker of social position, may explain why the sociodemographic determinants of interest in advice were identified.

5. Conclusion

Lung cancer screening may offer an opportunity to provide advice about a range of lifestyle-related risk factors which may be prevalent among lung screening attendees. Future work should focus on developing effective and acceptable interventions in this setting, while ensuring strategies are aligned with those informing informed participation in lung screening.

Conflict of interest statement

None declared.

Funding

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Role of the funding source

The funding sources did not contribute to the development of the study or preparation of the manuscript.

Appendix A. Supplementary data

Supplementary materials related to this article can be found, in the online version, at https://doi.org/10.1016/j.jst.2016.11.006.

References

[Please provide a list of references with proper citations and references to the document.]
Appendix H. Conversation Time questions and schedule

Asking 5 times a day (9am, 12pm, 3pm, 6pm, and 9pm):

1. What is your current location? Please select one.
   1) At home
   2) At work
   3) At the supermarket
   4) In a shopping centre/town centre
   5) At a friend or family member's house
   6) In a restaurant/cafè
   7) In a bar/pub
   8) At the park
   9) In a museum/gallery
   10) At the cinema/theatre
   11) At the gym
   12) At the GP surgery
   13) At the hospital
   14) Other. If 'other' location, please specify

2. What are you doing?
   1) Working
   2) Commuting
   3) Exercising
   4) Watching TV
   5) Reading
   6) Socialising
   7) Housework/Chores
   8) Eating
   9) Playing a game
   10) Other. If 'other' activity, please specify

3. Who are you with?
   1) Family
   2) Partner
   3) Friends
   4) Colleagues
   5) Alone
   6) Acquaintance
   7) Strangers
   8) Other. If 'other' company, please specify

4. Thinking about yourself and how you feel right now, to what extent do you feel [item]. Please select one response between 1 and 5, where Very slightly or not at all = 1 and Extremely = 5

<table>
<thead>
<tr>
<th>Item</th>
<th>Response options (presented separately for each item)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Upset</td>
<td>1) 1. Very slightly or not at all</td>
</tr>
<tr>
<td>2) Hostile</td>
<td>2) 2</td>
</tr>
<tr>
<td>3) Alert</td>
<td>3) 3</td>
</tr>
<tr>
<td>4) Ashamed</td>
<td>4) 4</td>
</tr>
<tr>
<td>5) Inspired</td>
<td>5. Extremely</td>
</tr>
<tr>
<td>6) Nervous</td>
<td></td>
</tr>
<tr>
<td>7) Determined</td>
<td></td>
</tr>
<tr>
<td>8) Attentive</td>
<td></td>
</tr>
<tr>
<td>9) Afraid</td>
<td></td>
</tr>
<tr>
<td>10) Active</td>
<td></td>
</tr>
</tbody>
</table>
5. How confident are you that you can engage in physical activity that increases your heart rate for at least 10 min during the next few hours? Please select one response on the scale between 0 and 10, where 0=not at all confident and 10=completely confident

6. If a health professional were to call you sometime over the next few hours (at a time of your choosing), would you be open to a conversation about increasing your physical activity to prevent cancer? Please select one response on the scale between 1 and 10, where 1=not at all open to this and 10=very open to this.

**Asked at 9am only (in addition to the above questions):**

1. Compared to the average person your age, gender, and race, how would you rate your chances of developing cancer sometime in your life? Please select one response.
   - 1) Much Lower
   - 2) Moderately lower
   - 3) Somewhat lower
   - 4) About the same
   - 5) Somewhat higher
   - 6) Moderately higher
   - 7) Much higher

2. How fearful are you about developing cancer in the future? Please select a response.
   - 1) Not at all fearful
   - 2) Low fear
   - 3) Slightly fearful
   - 4) Neutral
   - 5) Somewhat fearful
   - 6) Very fearful
   - 7) Extremely fearful

3. I feel very vulnerable to cancer. Please select a response.
   - 1) Strongly disagree
   - 2) Disagree
   - 3) Somewhat disagree
   - 1) Neither agree nor disagree
   - 2) Somewhat agree
   - 3) Agree
   - 4) Strongly agree

4. On a scale from 0 to 10, where 0 is not at all concerned and 10 is extremely concerned, please rate our level of concern about developing cancer in the future. Please select one response.

**Asked at 9am on day one only (in addition to the above questions):**

1. Thinking about your upcoming screening appointment (bowel scope, breast or cervical), how much pain do you expect to feel during the test?
   - 1) None
   - 2) Mild
3) Moderate
4) Severe

2. How much embarrassment do you expect to feel during the test?
   1) None
   2) Mild
   3) Moderate
   4) Severe

Asked at 6pm on day six only (in addition to the above questions):

1. Thinking about your screening appointment today (bowel scope, breast or cervical), how much pain did you feel during the test?
   1) None
   2) Mild
   3) Moderate
   4) Severe

2. How much embarrassment did you feel during the test?
   1) None
   2) Mild
   3) Moderate
   4) Severe
## Appendix I. Conversation Time Screening and Baseline Questionnaires

### Eligibility

<table>
<thead>
<tr>
<th>Item</th>
<th>Study eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever been diagnosed with cancer?</td>
<td>If participant answers ‘YES’ researcher will contact participant to determine</td>
</tr>
<tr>
<td>Yes □ No □</td>
<td>eligibility based on cancer type and stage of treatment.</td>
</tr>
<tr>
<td>If yes, what type of cancer were you diagnosed with?</td>
<td></td>
</tr>
<tr>
<td>…………………………………………………………</td>
<td></td>
</tr>
<tr>
<td>2. Do you have a NHS screening appointment (bowel scope, breast and</td>
<td>Participant eligible to continue if they select ‘YES’</td>
</tr>
<tr>
<td>cervical) arranged to take place?</td>
<td></td>
</tr>
<tr>
<td>Yes □ No □</td>
<td></td>
</tr>
<tr>
<td>If yes, what type of screening appointment has been arranged</td>
<td></td>
</tr>
<tr>
<td>(bowel scope, breast or cervical)?</td>
<td></td>
</tr>
<tr>
<td>- Bowel scope (flexible sigmoidoscopy) □</td>
<td></td>
</tr>
<tr>
<td>- Breast screening (mammogram) □</td>
<td></td>
</tr>
<tr>
<td>- Cervical screening (smear test) □</td>
<td></td>
</tr>
<tr>
<td>If yes, when is your appointment arranged to take place?</td>
<td></td>
</tr>
<tr>
<td>…………………………………………………………</td>
<td></td>
</tr>
<tr>
<td>3. Do you have an Android/iPhone phone?</td>
<td>Participant eligible to continue if they select ‘YES’</td>
</tr>
<tr>
<td>Yes □ No □</td>
<td></td>
</tr>
<tr>
<td>4. Which version of Android/iPhone do you have?</td>
<td></td>
</tr>
<tr>
<td>…………………………………………………………</td>
<td></td>
</tr>
<tr>
<td>5. What is your preferred method of communication?</td>
<td></td>
</tr>
<tr>
<td>Post □ Email □ Phone □</td>
<td></td>
</tr>
</tbody>
</table>
**Baseline questionnaire**

*Participant only to receive baseline questionnaire if they have an upcoming NHS screening appointment and have an Android / iPhone.*

1. How old are you? (in years)  
   2. What is your sex?  
      - Male □  
      - Female □  

3. What hand do you write with?  
   - Right □  
   - Left □  

4. At what age did you first leave education? (in years)  

5. Which educational or professional qualifications do you have? *Please tick all that apply.*  
   a) GSCE/School certificate/O-level/CSE □  
   b) Vocational qualifications (e.g. NVQ1+2) □  
   c) A-level/Higher school certificate or equivalent (e.g. NVQ3) □  
   d) Bachelor Degree or equivalent (e.g. NVQ4) □  
   e) Masters/PhD/PGCE or equivalent □  
   f) Still studying □  
   g) No formal qualifications □  
   h) Other (please specify) …………………………………………………. □

6. What is your current employment situation? *Please tick one option.*  
   a) Employed full-time □  
   b) Employed part-time □  
   c) Self-employed □  
   d) Unemployed and looking for work □  
   e) Full-time education □  
   f) Retired □  
   g) Unable or too ill to work □  
   h) Voluntary work □  
   i) Other (please specify) ……………………………………………… □

7. What is your current marital status?  
   a) Married/living with partner □  
   b) Single □  
   c) Divorced □  
   d) Separated □  
   e) Widowed □  
   f) Other (please specify) ………………………………………………… □

8. Please tick the box which best describes your living arrangement:  
   a) Alone □  
   b) With partner only □  
   c) With immediate family (including children) □  
   d) With other family □  
   e) With friends □
9. Which of these best describes your ethnic group?
   a) White British ☐
   b) White Irish ☐
   c) Any other White (please specify) …………………………………… ☐
   d) Black African ☐
   e) Black Caribbean ☐
   f) Any other Black (please specify) …………………………………… ☐
   g) Indian ☐
   h) Bangladeshi ☐
   i) Pakistani ☐
   j) Chinese ☐
   k) Any other Asian (please specify) …………………………………… ☐
   l) Mixed White and Black African ☐
   m) Mixed White and Black Caribbean ☐
   n) Mixed White and Asian ☐
   o) Any other mixed (please specify) …………………………………… ☐
   p) Any other (please specify) ……………………………………… ☐

10. Do you use the internet? (e.g. for health information)
   Yes ☐
   No ☐

11. Do you have any of the following health problems? Please tick all that apply.
   Osteoporosis ☐
   Arthritis ☐
   Diabetes ☐
   Angina ☐
   Asthma ☐
   Heart attack ☐
   Emotional or psychiatric illness ☐
   Heart murmur ☐
   Stroke ☐
   Irregular heart rhythm ☐
   Parkinson's disease ☐
   Any other heart trouble ☐
   Alzheimer's disease or dementia ☐
   Cancer ☐
   Lung disease ☐
   Other (Please specify) …………………………………… ☐

12. Has anyone in your family had cancer?
   Yes ☐
   No ☐
   If yes, please specify the type of cancer ……………………………………
   If yes, please specify their relation to you ……………………………………

13. What is your height? Please answer in either feet and inches (ft in) or in centimetres (cm).
   Ft in ……………………………
   Cm ……………………………

14. What is your weight? Please either answer in stone and pounds (st lbs) or in kilograms (kg)
15. Do you smoke/chew tobacco at all nowadays?
   - Yes √
   - No  □

   If no... Did you ever smoke/chew tobacco regularly (at least once a day)?
   - Yes √
   - No  □

   When did you quit smoking/chewing tobacco?
   - Year ..............
   - Month ..............

16. In the past week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job. Please only select one response.

   - None  □
   - 1  □
   - 2  □
   - 3  □
   - 4  □
   - 5  □
   - 6  □
   - 7  □

17. On the days when you exercised for at least 30 minutes, about how many minutes of exercise did you do? Please give an average if it varies per day.
   - ...........................................................
Appendix J. Data-prompted interview topic guide

Preamble

1. Introductions
2. Permission to record interview

Part 1: EMA data-prompted interview

“During the 11 days that you took part in this study you helped us to collect lots of data, including ratings of how worried you are about cancer, how you were feeling at different times of day, and how open you would be to a conversation about physical activity and cancer prevention. In the first part of this interview we are going to be looking through that data to help us talk about your experience of bowel cancer screening.”

1. Before we look at some of that data, can you start by telling me what it was like to attend XXXX screening?

Prompts

1. Was it your first time attending XXXX screening?
2. Did you tell anyone about going to the screening? What were those conversations like?
3. Was it easy for you to arrange time off work to go to the screening appointment?
4. Did you take someone along to the screening? Was it easy to find someone to accompany you?
5. Did you have to wait a long time before your appointment?
6. Was the screening as you had expected? Was it more/less comfortable/embarrassing/painful than you had expected before you went there?

Graphical displays of the following data will be generated in advance of the interview.

a) Perceived risk of bowel cancer
b) Cancer worry
c) Affect
d) Outcome expectancies
e) Current health
f) Self-efficacy
g) Accelerometer data
h) Openness to a conversation about PA and cancer prevention

Participants will be presented with each of the graphs in turn, and asked to describe them in relation to their experience of bowel scope screening.

Q’s 2 – 9) “The graph in front of you shows your ratings of XXXX before, on the day of, and after your bowel scope screening appointment. Please use this graph to tell me about your feelings of XXXX over this time.”

Where necessary and appropriate, the following prompts will be used for each graph.

1. Can you tell me about XXXX on the days leading up to the bowel scope appointment?
2. I can see that you rated XXXX as high / low here, why do you think that was?
3. And how do you think that XXXX changed on the day of your bowel appointment? Can you explain why that might be?
4. Please tell me about XXXX in the days following your bowel screening appointment.
5. It looks like your rating of XXXX increased / decreased at X time. Why you think that may be?
6. How do you think that this relates to your screening appointment?
7. And how do you feel about XXXX now?
8. What do you think XXXX graph shows?

Part 2: Openness to a conversation about physical activity and colorectal cancer prevention

“The second part of this interview follows on from the final graph that we looked at, about your openness to a conversation about physical activity and cancer prevention”

If participant is open to a conversation about PA and cancer prevention

1. I see that you had a really high score for openness for this type of discussion on day xx. Could you tell me more about why you think you felt that way then?

Or/And

2. I see that you weren’t so open to this kind of discussion on day xx – could you tell me more about why that was? What was different between this day and the other day [the day that they had a high score for openness]?

Where necessary and appropriate, the following prompts will be used.

1. When do you think would be the best time to have a conversation about physical activity and cancer prevention?
2. Why do you think that this would be the best time to have that conversation?
3. What kind of information would you like to receive in this conversation? Why?
4. Who do you think would be the best person to have this conversation with? Why?

If participant is not open to a conversation about PA and cancer prevention.

1. Why do you think that bowel cancer screening is not the right time to talk about physical activity and cancer prevention?
2. Can you think of a better time to have a conversation about physical activity and cancer prevention? Why?
3. What kind of information would you want to get? Why?
4. Who do you think would be the best person to have this conversation with? Why?

Part 3: Acceptability of the EMA methodology

1. How easy or difficult did you find the app to use?
2. How did you find recoding your data each day?
3. Is there any extra information that you would like to have been given in the app or as part of the study?
4. Is there anything in particular that you liked about the app/study?
5. Is there anything that you disliked about the app/study?

Closing remarks and thanks

1. Is there anything that you would like to add?
2. Give participant contact details of researcher
3. Thank participant for their time
Appendix K. Graphical summary of Conversation Time data
(example of a single participant’s data)
I feel very vulnerable to cancer

On a scale from 0 to 10, where 0 is not at all concerned and 10 is extremely concerned, please rate your level of concern about developing cancer in the future.
Describe how you would rate your current overall health

If I exercise five times per week, I will reduce my cancer risk. Please select one response between 1 and 4, where 1=Disagree and 4=Agree
How confident are you that you can engage in physical activity that increases your heart rate for at least 10 min during the next few hours?

If a health professional were to call you sometime over the next few hours (at a time of your choosing), would you be open to a conversation about increasing your physical activity to prevent cancer?
### Appendix L. Example of analytic framework

#### Chart 1. Experience of cancer screening (example)

<table>
<thead>
<tr>
<th>ID</th>
<th>Anticipation of the screening appointment</th>
<th>Previous experience of cancer screening</th>
<th>Experience of the cancer screening appointment</th>
<th>Value judgements about cancer screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The participant reported feeling a little apprehensive before the appointment as it was their first time attending cervical screening at a new surgery. (p3)</td>
<td>Participant had previous experience of cervical screening with a borderline result around 10 years ago. This meant attending multiple screening appointments but no treatment. (p1-2)</td>
<td>Participant saw an unfamiliar nurse in a new surgery. Squeamish about medical procedures ‘down there’. Participant told nurse about using a longer speculum but was ignored which meant additional stress and difficulty performing smear. (p2)</td>
<td>Despite difficult appointment participant would still advocate screening to friends. Participant grateful that the screening is free. (p3). Participant reported some confusion about the procedure itself and how it detects cancer ‘Is she randomly? You know, like passing the stick around and hoping to pick something up?’ (p4). Participant feels vulnerable to cancer based on family history and feels that screening is something that can make a difference in terms of catching it early (link) (p9).</td>
</tr>
<tr>
<td>ID</td>
<td>Weighing up personal risk factors</td>
<td>Psychological responses to risk (vulnerability etc.)</td>
<td>Behavioural responses to risk</td>
<td>Unpredictability / uncontrollability / inevitability of cancer</td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------</td>
<td>---------------------------------------------</td>
<td>------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>This participant weighs up current behaviour (e.g. non-smoker) with family history of cancer, but makes judgement that risk is higher due to family history of lung cancer.</td>
<td>The participant reports delayed negative response (following borderline cervical screening and death of mother) feeling worried about cancer (leaving people if she died) a couple of years later. Participant reports persistent worry but not stress about cancer 'It's always there in the back of my mind. I'm not overly stressed about it. I'm worried about it but not stressed, if that makes sense. It's not... it's not eating me up but it's always there in the back of my mind' (p5-6). High levels of distress and concern.</td>
<td>Participant reports feeling vulnerable to cancer. They see cancer as an inevitability so cancer screening is something they can do proactively (p7). Participant talks about benefits of screening and catching it early to make a difference.</td>
<td>Participant reports feeling vulnerable and concerned about cancer due to the lack of control they have over it, and the randomness &quot;that's why I feel vulnerable, just because I feel it's out of my control, if it's meant to happen.&quot; (p8).</td>
</tr>
<tr>
<td>ID</td>
<td>Psychological responses</td>
<td>Behavioural responses</td>
<td>Stability and variability of constructs in relation to appointment</td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>For this participant, the cancer screening appointment prompted feelings of fear and anxiety (p4)</td>
<td>Prior to the appointment the participant reported searching for information online about her upcoming screening appointment, hoping to pre-empt the result of the screening appointment (p5). &quot;I was batshit cuckoo, and crazy, and nervous. That's... That's how I felt. I felt like I was searching the internet like I, I had a PhD... I just felt highly stressed with, err, of, being scared of the unknown.&quot; (p8)</td>
<td>This participant's affective responses, feelings of risk and fear changed in directly in response to the screening appointment. &quot;So, it was, it was heavily, it was heavily worried, during the time I was, it, it, I was overly-worried. Whereas, it would have maybe been a 5 or a 4, the reason it was over, err, 7 and above, was because of, I was nervous about my appointment, and of the results&quot; (p6).</td>
<td></td>
</tr>
</tbody>
</table>
### Chart 4. Receptivity to physical activity advice (example)

<table>
<thead>
<tr>
<th>ID</th>
<th>Previous experience of discussing lifestyle with healthcare professionals</th>
<th>Information needs and preferences</th>
<th>General receptivity to PA advice</th>
<th>Receptivity to PA advice at cancer screening</th>
<th>Screening as a teachable moment</th>
<th>Timeliness of the teachable moment</th>
<th>Information overload</th>
<th>Information in relation to screening results</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>N/A</td>
<td>Participant would like information about what is going on locally e.g. exercise classes (p12) Important for information to be linked to the doctors surgery and to come from a healthcare professional (p13). “I’d rather have that conversation with a professional in an appointment instead of going online to scare myself.” (p14)</td>
<td>This person’s general receptivity (not @ screening appointment specifically) was highly dependent on what else is going on at that time (e.g. work and other commitments) (p11).</td>
<td>Participant felt that screening was a good opportunity to discuss PA and cancer prevention Participant thought that they would have felt comfortable having that conversation as they had already exposed themselves (p14). “Yeah. You’ve already just exposed your, umm, [laughing] yeah...There’s no, there’s no conversation you can’t broach at that point.” (p14)</td>
<td>Participant thought that as cancer is already going to be playing on people’s minds, cancer screening would be a good opportunity to give information (p13)</td>
<td>Participant was highly anxious in the lead up to the screening appointment, but some of the stress did go away after the appointment (p9).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix M. Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist


<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Guide questions/description</th>
<th>Reported on Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain 1: Research team and reflexivity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Interviewer/facilitator</td>
<td>Which author/s conducted the interview or focus group?</td>
<td>Section 7.2.3</td>
</tr>
<tr>
<td>2.</td>
<td>Credentials</td>
<td>What were the researcher's credentials? E.g. PhD, MD</td>
<td>Section 7.4.1</td>
</tr>
<tr>
<td>3.</td>
<td>Occupation</td>
<td>What was their occupation at the time of the study?</td>
<td>Section 7.4.1</td>
</tr>
<tr>
<td>4.</td>
<td>Gender</td>
<td>Was the researcher male or female?</td>
<td>N/A</td>
</tr>
<tr>
<td>5.</td>
<td>Experience and training</td>
<td>What experience or training did the researcher have?</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td><strong>Relationship with participants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Relationship established</td>
<td>Was a relationship established prior to study commencement?</td>
<td>Section 7.2.2</td>
</tr>
<tr>
<td>7.</td>
<td>Participant knowledge of the interviewer</td>
<td>What did the participants know about the researcher? E.g. personal goals, reasons for doing the research</td>
<td>Section 7.2.3</td>
</tr>
<tr>
<td>8.</td>
<td>Interviewer characteristics</td>
<td>What characteristics were reported about the interviewer/facilitator? E.g. Bias, assumptions, reasons and interests in the research topic</td>
<td>Section 7.4.1</td>
</tr>
<tr>
<td><strong>Domain 2: study design</strong></td>
<td></td>
<td></td>
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<tr>
<td>9.</td>
<td>Methodological orientation and Theory</td>
<td>What methodological orientation was underpin the study? E.g. grounded the discourse analysis, ethnography, phenomenology, content analysis</td>
<td>Section 7.2.5</td>
</tr>
<tr>
<td>10.</td>
<td>Sampling</td>
<td>How were participants selected? E.g. purposive, convenience, consecutive, snowball</td>
<td>Section 7.2.2</td>
</tr>
<tr>
<td>11.</td>
<td>Method of approach</td>
<td>How were participants approached? E.g. face-to-face, telephone, mail, email</td>
<td>Section 7.2.2</td>
</tr>
<tr>
<td>12.</td>
<td>Sample size</td>
<td>How many participants were in the study?</td>
<td>Section 7.2.2</td>
</tr>
<tr>
<td>13.</td>
<td>Non-participation</td>
<td>How many people refused to participate or dropped out? Reasons?</td>
<td>Section 7.2.2</td>
</tr>
<tr>
<td></td>
<td><strong>Setting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Setting of data collection</td>
<td>Where was the data collected? E.g. home, clinic, workplace</td>
<td>Section 7.2.3</td>
</tr>
<tr>
<td>15.</td>
<td>Presence of non-participants</td>
<td>Was anyone else present besides the participants and researchers?</td>
<td>Section 7.2.3</td>
</tr>
<tr>
<td>16.</td>
<td>Description of sample</td>
<td>What are the important characteristics of the sample? E.g. demographic data, date</td>
<td>Section 7.3.1</td>
</tr>
<tr>
<td></td>
<td><strong>Data collection</strong></td>
<td></td>
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</tr>
<tr>
<td>17.</td>
<td>Interview guide</td>
<td>Were questions, prompts, guides provided by the authors? Was it pilot tested?</td>
<td>Section 7.2.3</td>
</tr>
<tr>
<td>18.</td>
<td>Repeat interviews</td>
<td>Were repeat interviews carried out? If yes, how many?</td>
<td>Section 7.2.3</td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td>Section(s)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Audio/visual recording Did the research use audio or visual recording to collect the data?</td>
<td>Section 7.2.3</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Field notes Were field notes made during and/or after the interview or focus group?</td>
<td>Section 7.2.5</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Duration What was the duration of the interviews or focus group?</td>
<td>Section 7.2.3</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Data saturation Was data saturation discussed?</td>
<td>Section 7.2.5</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Transcripts returned Were transcripts returned to participants for comment and/or correction?</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

**Domain 3: analysis and findings**

**Data analysis**

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.</td>
<td>Number of data coders How many data coders coded the data?</td>
<td>Section 7.2.5</td>
</tr>
<tr>
<td>25.</td>
<td>Description of the coding tree Did authors provide a description of the coding tree?</td>
<td>Section 7.2.5</td>
</tr>
<tr>
<td>26.</td>
<td>Derivation of themes Were themes identified in advance or derived from the data?</td>
<td>Section 7.2.5</td>
</tr>
<tr>
<td>27.</td>
<td>Software What software, if applicable, was used to manage the data?</td>
<td>Section 7.2.5</td>
</tr>
<tr>
<td>28.</td>
<td>Participant checking Did participants provide feedback on the findings?</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Reporting**

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.</td>
<td>Quotations presented Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number</td>
<td>Sections 7.3.2 to 7.2.6</td>
</tr>
<tr>
<td>30.</td>
<td>Data and findings consistent Was there consistency between the data presented and the findings?</td>
<td>Sections 7.3.2 to 7.2.6</td>
</tr>
<tr>
<td>31.</td>
<td>Clarity of major themes Were major themes clearly presented in the findings?</td>
<td>Sections 7.3.2 to 7.2.6</td>
</tr>
<tr>
<td>32.</td>
<td>Clarity of minor themes Is there a description of diverse cases or discussion of minor themes?</td>
<td>Sections 7.3.2 to 7.2.6</td>
</tr>
</tbody>
</table>