Comparing the Effects of Intermittent Fasting and Continuous Calorie Restriction on Eating Disorder and Mood Symptoms in Healthy Dieters

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I 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.

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Overview

This three-part thesis is focused on the impact of calorie restriction diets on eating disorder and mood symptoms.

Part One is a conceptual introduction for the empirical paper. It provides the context in which calorie restriction diets have developed, acknowledges the previous research demonstrating potential health benefits, and the association between diets and eating disorders. It then reviews the existing literature on calorie restriction and psychological outcomes, highlighting the inconsistency in findings.

Part Two presents empirical research into the effect of commencing either an intermittent or continuous calorie restriction diet on symptoms of eating disorders, food craving and mood in healthy adults. The study found that commencing a diet was associated with reductions in shape concern, weight concern, binge-eating disorder symptoms, food craving and mood symptoms over the four weeks of dieting. The IF group reported greater reductions in shape and weight concern than the CCR group, and lower levels of eating concern after four weeks of dieting compared to the CCR group. Both groups reported increased restraint scores over the four weeks of dieting, and this was significantly higher for the CCR. For the IF participants, high levels of dichotomous thinking were associated with less reduction in food cravings. For CCR participants, high scores on self-esteem were associated with less reduction in scores for mood symptoms. The empirical research was completed as part of a joint research project (O’Leary, J. (2019). The impact of the 5:2 intermittent fasting diet on cognition in healthy adults. Clinical Psychology Doctorate Thesis).

Part Three is a critical appraisal of the conceptual introduction and the empirical study. It includes reflections of the processes involved and lessons learnt.
Impact statement

The understandings and insight presented in this thesis, in both the conceptual introduction and the empirical paper, have the potential to impact the academic and clinical fields of dieting and eating disorders.

The conceptual introduction highlights the inconsistency in the methodology and findings of previous research exploring the impact of calorie restriction diets on psychological outcomes such as symptoms of eating disorders and mood. With regards to the academic impact, it is hoped that this knowledge will inform the methodology used by future researchers depending on their research questions. Ultimately, it is hoped that there will be a clearer understanding of the impact of commencing a calorie restriction diet on symptoms of eating disorders and mood, which will inform psychological theories of the development of eating disorders and help those considering commencing a diet to choose the one most appropriate for their particular needs.

The conceptual introduction also stresses the lack of research and thus awareness of the psychological outcomes of commencing the highly popular, ‘5:2’ intermittent fasting diet, in the context of the potential harmful effects of starting a continuous calorie restriction diet. It also begins to consider certain individuals who might be more at risk of adverse effects of dieting, based on current knowledge of eating disorder risk factors. This highlights the need for further research exploring the impact of intermittent fasting on psychological outcomes, particularly in those at-risk populations.

The empirical paper explores the impact of commencing the ‘5:2 - Fast Diet’ on eating disorder symptoms, binge-eating frequency and symptoms, food craving and mood symptoms, in comparison to commencing a daily low calorie diet. The paper
will be disseminated through UCL Discovery in the first instance, and will be submitted for publication in a peer-reviewed journal. To the best of the author’s knowledge, this is the first study to compare the impact of the different types of calorie restriction on psychological outcomes. Given the popularity of intermittent fasting, it is hoped that this study will inspire further research into this area, using the limitations of this study as information to guide methodology. Research in this area has the potential to support adults wanting to start a calorie restriction diet in making a decision about what is the most appropriate and safe diet for them.

The results demonstrated overall beneficial psychological outcomes associated with commencing the intermittent fasting diet. In the context of globally increasing overweight- and obesity-related mortality, with more research in this area, these results have the potential to inform health guidelines.
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Part One: Conceptual Introduction

The Impact of Calorie Restriction on Eating Disorder and Mood

Symptoms: Is Intermittent Fasting Safe for Humans?
Abstract

Over the years, a substantial amount of research has been undertaken to improve our understanding of the association between calorie restriction (CR) diets and symptoms of eating disorders. Whilst theorists in the eating disorder field are concerned that CR increases the likelihood of developing disordered eating, particularly binge-eating, theorists in the field of health and ageing are exploring the potential health benefits, such as increased longevity. The ‘5:2 - Fast Diet’ is a highly popular form of intermittent CR, which is practiced across the world, often with no supervision. It is therefore important to understand more about the psychological consequences of starting such a regime.

This conceptual introduction critically reviews the literature exploring both continuous and intermittent CR diets and psychological outcomes. A PubMed search was conducted, which identified 107 papers, of which 38 were selected based on their relevance. The references of the identified papers were also hand searched to identify further relevant studies.

This introduction demonstrates that the evidence for an association between CR, continuous and intermittent, and symptoms of eating disorders is not clear. Whilst the differences in the previous research designs are likely to impact on the inconsistency in findings, the different types of CR regimes and individual risk factors for eating disorders are also discussed as contributing factors.
1.0 Introduction

In the late 1900s, a host of laboratory research supported theories that suggested calorie restriction (CR) is a significant risk factor in the development of eating disorder symptomology. Such theories asserted that CR has counter-regulatory effects, as data demonstrated that it commonly results in over-eating and any weight initially lost is ultimately regained (e.g. Polivy & Herman, 2017). This led to an anti-dieting movement amongst lay people and researchers that continues to exist today (e.g. Bacon & Aphramor, 2011). More recently, however, the majority of research on CR has focused on the exploration of its potentially positive impact on the biology of ageing in animals and humans (Fontana, Partridge, & Longo, 2010b). This has led to the ‘CRONies movement’ (Calorie Restriction with Optimal Nutrition), whereby individuals restrict their calorie intake on a daily basis with the goal of increasing longevity (Fontana, Meyer, Klein, & Holloszy, 2004). In light of the potential health benefits, researchers have started to explore alternative, more accessible forms of CR, such as intermittent fasting (IF) with the view that continuous CR (CCR) is not sustainable for humans (Most, Tosti, Redman, & Fontana, 2017).

The first long-term randomised control trial (RCT) of CR in humans, the CALERIE study, has explored the impact of reducing daily calorie intake in non-obese humans and has found positive results on weight loss and biological markers of longevity (e.g. Heilbronn et al., 2006) and psychological factors (e.g. Redman, Martin, Williamson, & Ravussin, 2008; Williamson et al., 2008). However, very little is known about the psychological impact of IF, of which the 5:2, sometimes known as the ‘Fast Diet’, is a popular example.
This conceptual introduction will firstly aim to set the context in which CR diets have developed, distinguish between the different types of CR and use of such diets by the general population; acknowledging the potential health benefits. The main aim is to review the existing literature on CCR and IF, and the effects of the diets on psychological outcomes, such as eating disorder symptoms and adverse mood states. Furthermore, it will aim to uncover potential risk-factors associated with eating disorder symptomology, which may increase the likelihood of developing adverse psychological outcomes whilst restricting one’s calorie intake.

2.0 Background

2.1 Overweight and obesity

Overweight and obesity have been defined as ‘abnormal or excessive’ fat accumulation that may harm one’s health and are defined according to Body Mass Index (BMI) (World Health Organisation, 2018). BMI is calculated as weight in kilogrammes divided by height in metres squared. The World Health Organisation classifies adults with a BMI greater than or equal to 25 as overweight, and adults with a BMI greater than or equal to 30 as obese. The prevalence of obesity has increased globally over the past few decades and presents a major public health concern (Inoue, Qin, Poti, Sokol, & Gordon-Larsen, 2018). In 2015, high BMI contributed to 4 million deaths and 120 million disability-adjusted life-years globally (Afshin et al., 2017). Overweight and obesity are major risk factors for several life-threatening health conditions, such as cardiovascular diseases (CVD), including heart attacks and strokes, type 2 diabetes mellitus, and some cancers (for a review, see Chu et al., 2018). A cluster of reversible metabolic abnormalities were identified in overweight individuals and have been linked to the development of health conditions such as CVD and type two diabetes (Raeven, 1997).
Simply put, overweight and obesity are the result of a sustained imbalance between energy intake and energy expenditure; individuals continuously consuming more energy than they require based on their usage (Hill, Wyatt, & Peters, 2012). It therefore makes sense that therapeutic lifestyle changes, such as an increase in physical activity and dietary modifications are the first line treatment for reversing metabolic abnormalities associated with weight gain (Qiao, Gao, Zhang, Nyamdorj, & Tuomilehto, 2007).

### 2.2 Dietary modification

Dietary modification or dieting refers to intentional restriction of food intake for the purpose of weight loss or improving health. Examples of dieting are avoiding high calorie foods, reducing portion sizes and not eating to the point of satiation (Bryant, King, & Blundell, 2007; Fontana, Partridge, & Longo, 2010a). Two of the most widely used forms of dieting are calorie restriction and intermittent fasting (Skaznik-Witel & Polotsky, 2014).

**Health benefits of Calorie Restriction**

Calorie restriction (CR), also known as continuous calorie restriction (CCR) involves a consistent reduction in calorie intake. It is typically defined by a decrease of between 10–40% in normal or recommended calorie intake (Chung et al., 2013; Willcox & Willcox, 2014). The beneficial effects of CR on obesity and related diseases have long been recognised across different species, contributing to a significant reduction in morbidity and mortality (Fontana et al., 2010b). Nearly a century of research has explored and expanded upon McCay and colleagues (1935) report that CR with optimum nutrition (CRON) prolongs mean and maximal lifespan, following their laboratory research on male and female rats (McDonald & Ramsey, 2010). It is not well understood how exactly CR interferes with the ageing
process. Studies of CR in rodents and primates have demonstrated an increase in insulin sensitivity and a reduction in oxidative damage to proteins, lipids and DNA (Anderson, Shanmuganayagam, & Weindruch, 2009); both of which would be expected to decrease risk of CVD and type two diabetes (Mattson & Wan, 2005).

Two leading hypotheses regarding the ‘anti-ageing’ effects of CR are the oxidative stress hypothesis (Sohal & Weindruch, 1996) and the stress resistance hypothesis (Mattson & Wan, 2005); both posit that prolonged CR increases cellular resistance to injury by responding to stress adaptively.

The National Institute of Aging have published results from a 20-year longitudinal study, exploring adult-onset moderate CR (30% restriction) in rhesus monkeys. Data suggested that CR reduced the incidence of several diseases, such as cancer, heart disease, and diabetes, and lowered the incidence of ageing-related deaths. At the point of reporting, 80% of the monkeys on the CR diet were alive compared to 50% of the monkeys on an ad libitum diet (Colman et al., 2009). However, a caveat of studies that use an ‘ad libitum’ diet as a control group is that the animals in this group tend to overeat and experience a lack of both mental and physical activity, resulting in them becoming obese (Le Bourg, 2018; Martin, Golden, Egan, Mattson, & Maudsley, 2007). It is therefore not surprising that animals who are not obese and are more physically and mentally active, looking for food in their cage, are healthier and thus live longer.

Whilst there is hope that the evidence linking CR with longevity in non-human primates will be applicable to humans, there is no data to confirm this. With survival being the primary outcome, it is difficult to design RCTs to definitively test the relationship between CR and longevity in humans (Martin et al., 2007; Ravussin, Gilmore, & Redman, 2016). Despite this, there have been systematic research studies
exploring the impact of CR on biomarkers of ageing in humans, and data collected from population studies and observations of individuals who voluntarily practice differing degrees of CR (for a recent review, see Most et al., 2017).

With regards to naturalistic (uncontrolled) studies, Okinawa, an island off mainland Japan, is known for its long average life expectancy. There are approximately 50 centenarians per 100,000 in a population of 1.3 million and there is an accompanying low risk of age-related diseases (Bernstein et al., 2004; Willcox, Willcox, Todorik, & Suzuki, 2009). The longevity advantage of Okinawa in comparison to mainland Japan and many other countries, is largely considered to be a result of a traditional low calorie, yet nutritionally dense diet (Willcox et al., 2009); as well as an increase in the size of the birth cohort at this time (Robine & Saito, 2003). This theory of association has been supported by the arrival of a westernised diet that has seen a reduction in the average life expectancy for individuals born after World War II (Gavrilova & Gavrilov, 2012).

Biosphere 2 was a self-sustaining ecological system in which eight non-obese crew members lived for two years (Walford, Mock, MacCallum, & Laseter, 1999). All crew members lost significant amounts of weight, considered to be a result of an unforeseen low daily calorie intake with increased energy expenditure. This allowed for an observational study of the health implications of CR with optimal nutrition, since crew members were supplied with all essential nutrients. Similar physiological improvements to those demonstrated in studies on rodents and monkeys were seen in the crew members across the two years, such as reduced blood pressure and lower glucose, insulin and glycated haemoglobin levels. Authors concluded that long term CR is health enhancing, as opposed to detrimental to health, as long as individuals consume adequate nutrients. However, several years after the study was published it
was discovered that the crew members were exposed to declining levels of oxygen, resulting in hypoxia (Paglia & Walford, 2005). It has since been speculated that the results found may have been influenced by this previously unknown variable (Most et al., 2017). Finally, the availability of members of a group called the Calorie Restriction Society, self-named “CRONies” has allowed for important observation studies by ageing researchers. The members practice self-imposed severe CR of approximately 30% daily, with the belief that CR will extend their lifespan beyond the usual range (Fontana, et al., 2004). Data suggests severe CR in non-obese humans significantly reduces percentage of body fat, cholesterol, blood pressure, insulin levels and blood glucose levels (Fontana et al., 2004).

The first long term RCT on CR in humans has recently been completed in the US. The Comprehensive Assessment of Long-term Effects of Reducing Intake of Energy (CALERIE) RCT compared two years of 25% CR with and without exercise, to eating as usual in non-obese, moderately overweight individuals. Phase one of the trial explored the effects of CR after the first 6 months. Data demonstrated that participants’ body weight and fat mass reduced; two biomarkers of longevity, fasting insulin level and body temperature were decreased; and metabolic adaptation developed at 3 and 6 months, resulting in a decline in DNA damage (Heilbronn et al., 2006). Results from phase two of the trial revealed that participants achieved a 12% calorie reduction rather than the 25% target. Despite this, they maintained a 10% body weight loss over two years and demonstrated positive effects on correlates of human survival and disease risk factors (Ravussin et al., 2015). A follow-up study found that weight, percentage of body fat and fat mass remained significantly less than the control group two years after the intervention had ended (Marlatt, Redman, Burton, Martin, & Ravussin, 2017). The authors acknowledged that caution should
be applied when generalising the results to the average person wanting to engage in a CR diet, as the participants were highly motivated and the intervention was very intense (Di Francesco & de Cabo, 2015).

Whilst research has demonstrated benefits of CR in humans, it has been speculated that it is impractical and very difficult for humans to sustain in the long run, especially given the current obesogenic environment (Most et al., 2017; Polivy & Herman, 2010; Polivy, Herman, & Coelho, 2008). Data collected six months following the end of the CALERIE study showed that the participants in the experimental groups reported a significantly increased desire to eat in comparison to participants in the control group (Redman & Ravussin, 2011; Williamson et al., 2008). As previously acknowledged, the participants in the CALERIE study were highly motivated, underwent moderate CR and were provided with the required foods, it has been suggested that these factors increased likelihood of adherence to the diet which would not necessarily be generalised to real-life dieting (Moreira, Most, Howard, & Ravussin, 2011). Thus researchers interested in the ageing process endeavoured to discover a form of CR that is safe and sustainable so that humans could reap the rewards of CR without such difficulty.

*Intermittent Fasting*

Fasting, a process whereby individuals abstain from consuming any foods or drinks for a set period of time, is an age-old practice. Modified fasting allows for an intake of a very small amount of food or fluid. Both fasting and modified fasting are utilised around the world, most commonly for religious or cultural reasons (Golbidi et al., 2017). Modified fasting has also been used therapeutically in medical settings, such as for individuals with chronic pain, as it is thought to trigger a beneficial neuroendocrine response (Michalsen et al., 2003).
More recently, fasting techniques have become popular for weight loss and improving health. Intermittent fasting (IF), also known as intermittent calorie restriction (ICR) usually involves eating a very low energy diet (VLED, 75-90%) on between one and three days per week, interchanged by periods of ad libitum calorie intake on non-restriction days (Harris, McGarty, Hutchison, Ells, & Hankey, 2018). IF is an umbrella term encompassing a number of specific diets. Alternate-day-fasting (ADF; Johnson, Laub, & Sujit, 2006; Varady & Hellerstein, 2007) and the 5:2 ‘Fast Diet’ (Mosley & Spencer, 2013, 2014) are particularly popular subtypes as they allow individuals to eat freely for much of the week (Barnosky, Hoddy, Unterman, & Varady, 2014) and to ‘cut back’ on certain foods for relatively short periods of time (Spencer & Schenker, 2013). Authors of the ‘Fast Diet’ claim that, with this diet, it is possible to “eat well, most of the time, and get slimmer and healthier as you do it” (Mosley & Spencer, 2013 pp. back cover). It has been hypothesised that IF diets are the safe and sustainable alternative to CR (Carlson & Hoelzel, 1946; Johnstone, 2015).

Research exploring the effects of IF on animals has demonstrated equally positive results, with regards to biological markers of ageing and obesity related disease, for IF as with CCR (Varady & Hellerstein, 2007). A review of the impact of IF on health and disease processes in animals reports that IF in fact reduces significantly higher levels of visceral fat, whilst retaining lean mass in comparison to daily CR (Mattson, Longo, & Harvie, 2017). Research on rodents has shown that even when IF results in no change in body weight, suggesting no reduction in overall calorie intake, improvements in physiological processes leading to increased longevity are still observed (Anson et al., 2003; Goodrick, Ingram, Reynolds, Freeman, & Cider, 1990). However, these results have not been demonstrated
consistently. A study of IF in mice, which demonstrated compensatory overeating on non-fast days and thus no change in weight, suggested that the IF diet did not increase longevity nor delay prostate tumour growth (Thomas et al., 2010).

With regards to the evidence of beneficial effects of IF on humans, a systematic review published in 2015 included 40 clinical trials (RCTs and pilot studies) that explored the physiological benefits of IF for humans. The review concluded that IF and CCR produce equivalent outcomes with regards to weight, waist or hip circumference, fat mass or fat free mass (FFM) lost, improvements in parameters related to glucose homeostasis, and drop-out rate (Seimon et al., 2015). More recent RCTs have demonstrated similar outcomes (Catenacci et al., 2016; Schübel et al., 2018; Trepanowski et al., 2017). Authors of the ‘Fast Diet’ claim that weight lost through IF is almost all fat and is usually abdominal fat, which is considered more unhealthy, in comparison to non-IF diets that result in reduction of FFM, such as muscle (Spencer & Schenker, 2013). However, a recent review of six RCTs exploring the potential benefits and harms of short-term IF compared to CCR reported that there has not been enough evidence to support this claim (Harvie & Howell, 2017). It has also been suggested that the amount of FFM lost during an IF diet differs according to the individual’s initial body weight and whether they are exercising alongside the diet; thus research would have to address these factors whilst measuring long term effects (Mattson et al., 2017).

3.0 Should humans be restricting their calorie intake?

Despite evidence demonstrating the physical health benefits of CR, exploration of the research demonstrates great variability in its success. Whilst it has been suggested that CR has a number of consequences, long term weight loss is rarely one of them (Anastasiou, Karfopoulou, & Yannakoulia, 2015; Hill, 2004; Klesges, Klem,
Of individuals who have lost around 10% of their body weight, only 20% are able maintain the loss for one year or more (Wing & Hill, 2001). Furthermore, researchers in the eating disorder field are concerned that CR diets have a detrimental impact on individuals’ psychological well-being, such as increased depression, obsession with food and body-weight and increased incidence of problematic eating behaviours (Manore, 1996). Evidence from a number of longitudinal studies demonstrates that individuals who engage in dieting behaviours are more likely to develop disordered eating patterns than non-dieters (Halvarsson-Edlund, Sjödén, & Lunner, 2008; Neumark-Sztainer et al., 2006; Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011; Stice, Gau, Rohde, & Shaw, 2017). A review of five longitudinal studies measuring the evolution of eating disturbances concluded that dieting behaviour plays an important role in the development of an eating disorder (Hsu, 1997). A more recent review of prospective risk factor studies demonstrated that dieting is a risk factor for the development of eating disorder symptoms in general and two specific eating disorders, bulimia nervosa and purging disorder. However, the author highlighted the limited number of such trials (Stice, 2016). Herman, Polivy and colleagues have published a large amount of research exploring the relationship between what they termed ‘dietary restraint’ and subsequent over-eating (e.g. Polivy & Herman, 2017). Whilst it was previously assumed that dieting is a consequence of over-eating, evidence presented suggests it may actually play a vital role in the development of this behaviour.

It is therefore important to better our understanding of the psychological outcomes of CR regimes. To review the literature exploring the impact of CCR and IF on psychological factors such as mood and eating disorder symptomology, a PubMed (https://www.ncbi.nlm.nih.gov/pubmed/) search was conducted (October
The following search terms were used: ((calori* restriction) OR fast* OR diet* OR (energy restriction) Or (restrained eating)) AND (mood OR depression OR anxiety OR (eating disorder) OR (bing*)), which produced 107 papers, of which 38 were selected based on their relevance. The references of the identified papers were also hand searched to identify further relevant studies. All papers that addressed the psychological implications of CR diets were selected and reviewed for the purpose of this conceptual introduction, in order to build a broader understanding of the association between CR and symptoms of eating disorders and mood. There were no other specific inclusion or exclusion criteria as this is beyond the scope of the conceptual introduction.

3.1 Literature exploring the impact of calorie restriction on eating disorder and mood symptoms

The Restraint Theory

Concerns regarding the psychological effects of CR date back to the Minnesota Starvation Experiment by Ancel Keys and colleagues (Keys, Brozek, Henschel, Mickelsen, & Taylor, 1950). Thirty-six healthy conscientious objectors volunteered to undergo extreme CR (around 50% of ad-lib diet) for six months towards the end of World War II (WWII), whilst maintaining their active lifestyle. Within six weeks of the diet, the participants were observed to be experiencing a range of psychological changes, including irritability, distress, confusion, apathy, and preoccupation with food. Each participant lost around 25% of their body weight before entering a ‘rehabilitation’ period, whereby an increase in calories was introduced. Participants were found to over-eat without relief from feelings of hunger, resulting in a further increase in calories given during this period. Almost 60 years after the initial study was published, interviews with 14 of the participants
provided qualitative data (Kalm & Semba, 2005). Participants recalled the difficult psychological consequences of CR and the persistent feelings of hunger during the rehabilitation period. Many reported eating excessively following completion of the study despite warnings against this. Participants reported that they regained the initial weight lost, one described binge induced vomiting and another a visit to hospital due to over-eating. Another study exploring the effects of extreme CR during WWII showed that veterans who had been taken captive and thus deprived of food reported significantly more binge-eating following the war, in comparison to veterans who had not been captured and on average gained weight during the war (Polivy, Zeitlin, Herman, & Beal, 1994). It is important to note that the individuals in these studies underwent a severe level of CR and were likely to have experienced malnutrition as a result of their circumstances, which is different from the type of CR advised by anti-ageing researchers. Furthermore, these studies lacked experimental rigor and thus the adverse psychological outcomes observed may have been a result of some other, confounding variables. Nonetheless, such studies introduced the idea that binge-eating is perhaps a consequence of CR, prompting theories aimed at explaining the phenomenon.

The ‘set-point theory’ (Nisbett, 1972), also known as the ‘relative deprivation model’ provides a biological explanation as to why eating increases and weight is regained following CR diets. The theory claims that one’s eating behaviour is regulated by a biologically determined ‘set-point’ body weight, which differs per individual based on the number of fat cells, or adipocytes, they possess. The number of adipocytes remains stable over one’s lifetime and is thought to be influenced both by genetics and early nutrition. Eating more or less than required changes the size of the adipocytes, which triggers the appropriate compensatory eating-behaviour to
bring about the weight into line with the pre-determined set-point. Thus environmental interventions for weight loss such as CR and exercise are considered futile. Telch and Agras (1996) systematically restricted individuals calorie intake and found all participants engaged in the appropriate compensatory behaviours when given access to food.

However, laboratory research has demonstrated that this is not always the case. In studies whereby individuals had their calorie intake restricted through omitting breakfast (Levitsky & Pacanowski, 2013) or snacks (Levitsky, 2002) from their diets, they experienced a calorie deficit. Similar findings were observed when lean men and women followed a 36-hour fast (Johnstone et al., 2002). Again, participants who were deprived of their calorie intake on one day did not alter energy intake on the other days of the week (Levitsky, 2005). In a study of prolonged CR, forty-eight overweight individuals did not rate significantly higher levels of appetite or hunger and did lose a significant amount of weight (Anton et al., 2009). Thus these studies did not provide evidence of dieters behaving in ways to compensate for the reduced energy intake. Furthermore, following a two week period of overfeeding, individuals energy intake returned to pre-overfeeding levels rather than reducing below this rate (Levitsky, 2002). Anecdotal evidence, such as the observation that one’s appetite can be aroused or depleted by external cues, such as being offered a highly palatable food or being too busy to eat, the knowledge that globally people are on average gaining weight, and that individuals who move to countries that typically have a higher calorie intake in their diet gain weight is evidence for an influence of body weight that is not wholly biological (Levitsky, 2005; Rogers, 1999). Thus suggesting the relationship between CR and subsequent
weight gain experienced by some people must be more complex than the biological ‘set-point’ theory posits.

Research indicates cognitive mechanisms are likely to influence the process. A study whereby individual’s cognitions were manipulated by presenting foods as either high or low calorie showed that subsequent eating was not accurately regulated to achieve caloric compensation (Wooley, 1972). Herman & Mack (1975) expanded on the idea that over-eating following CR is a result of cognitive processes rather than purely biological. They hypothesised that some individuals choose to restrain their eating, a cognitive process in itself, as a result of external pressures, according to cognitive rules. These rules thus work in attempt to ignore physiological pressures to eat, such as hunger and satiety, in order to keep body weight down. According to this ‘restraint theory’, when cognitive control is undermined by a situational factor, the restraint is broken and disinhibition and over-eating are triggered, resulting in ‘counter-regulatory’ behaviour. This hypothesis has been demonstrated in various laboratory studies. Herman and Mack found that female college students who were asked to either consume a high-calorie preload or not to do so differed in their subsequent eating behaviours based on their self-reported level of restrained eating. Highly restrained eaters ate more high-calorie foods following the preload compared to no preload; whereas low restrained eaters ate less high-calorie foods after the preload compared to no preload. Similar effects of ‘over-eating’ by restrained eaters were found as a result of experiencing negative mood states such as anxiety (Herman & Polivy, 1975; Polivy, Herman, & McFarlane, 1994), depression (Baucom & Aiken, 1981; Fay & Finlayson, 2011; Polivy & Herman, 1976a), fear (Cools, Schotte, & McNally, 1992) and loneliness (Rotenberg & Flood, 1999), following paying attention to body image ideals in the
media (Boyce & Kuijer, 2014) and following alcohol consumption (Caton, Nolan, & Hetherington, 2015; Polivy & Herman, 1976b). Furthermore, the coexistence of high levels of restrained eating and depression have been shown to significantly predict binge-eating over time (Greenberg & Harvey, 1986). It was thus concluded that cognitive control is an important mechanism, which affects the expression of physiologically based hunger, and if undermined can lead to counter-regulatory behaviour, i.e. over-eating.

The processes by which undermining cognitive control leads to overeating is likely to be both physiological and cognitive. The set-point theory would suggest that the highly restrained eaters are likely to eat more once the cognitive rules are broken due to the activation of physiological pressures to compensate for the previous energy restriction, to bring weight in line with set-point. However, laboratory research suggests that the appraisal made by the restrained eaters regarding the violation of the cognitive rule is key to the subsequent eating behaviour. For example, consumption of a typically ‘forbidden’ food such as a milkshake provided as a preload led to subsequent over-eating in restrained eaters; the number of milkshakes given or the label of high or low calories did not have a significant impact (Herman & Mack, 1975; Mills & Palandra, 2008). This suggests that the consumption of a food that is commonly perceived as ‘forbidden’ is enough to trigger disinhibited eating. In other studies, the perceived quantity of calories within the preload alone or in comparison to others has been found to affect the subsequent eating behaviour of restrained eaters but not non-restrained eaters; with restrained eaters eating more following a preload they perceive to be high in calories or higher in calories than those around them (Polivy, 1976; Polivy, Herman, & Deo, 2010). These findings are all suggestive of a dichotomous style of thinking, whereby
experiences are placed in one of two categories rather than a continuum; for example “all-or-nothing”, “good or bad” or “forbidden or allowed”. The importance of appraisals following a violation of a cognitive rule was addressed in Marlatt and Gordon’s abstinence violation effect (AVE) model (1985). The AVE model refers to a causal attribution for violating a period of abstinence that is internal, stable and global. Based on data from participants in a smoking cessation program, they asserted that individuals who relapse following a ‘slip’ are more likely to have higher AVEs than those who regain abstinence (Curry, Marlatt, & Gordon, 1987). Such a finding was demonstrated in a correlational study exploring the AVEs of individuals engaging in a very low calorie diet; those who attributed their first ‘lapse’ to internal, stable and global reasons lost a significantly smaller percentage of excess weight compared to those who attributed their first ‘lapse’ to external, unstable and specific reasons (Mooney, Burling, Hartman, & Brenner-liss, 1992).

A dichotomous style of thinking and high AVEs are implicit within the cognitive model of bulimia nervosa (BN; Fairburn, Cooper, & Shafran, 2003). The model suggests that individuals cycle between restricting calorie intake and binge-eating due to a dysfunctional system for evaluating their own self-worth; based upon their eating habits, shape, weight and the ability to control them. Such individuals are hypothesised to engage in CR in an attempt to increase their perceived self-worth. However, due to the difficulty in adhering to strict CR rules, efforts to restrict are often violated. This violation is perceived as a catastrophic personal failure, which triggers one to feel out of control, abandon efforts to restrict and subsequently binge-eat. CR eventually resumes in attempt to restore one’s self-worth, and the cycle is hypothesised to continue. According to this theory, it makes sense that individuals who previously had a diagnosis of anorexia nervosa (AN), whereby
individuals engage in chronic and severe CR, often develop binge-eating behaviour and, in about half of cases, full BN (Fairburn & Harrison, 2003).

Research on restrained eaters without a diagnosis of BN has linked low self-esteem to over-eating following a preload (Polivy, Heatherton, & Herman, 1988). This is perhaps because individuals with low self-esteem are more vulnerable to the influences of external cues, such as attractive food cues; a theory named ‘behavioural plasticity’ (Brockner, 1983). In line with this idea, research has shown that restrained eaters demonstrate higher levels of disinhibited eating behaviours in the presence of attractive food cues, such as seeing or smelling highly palatable foods, compared to unrestrained eaters (Polivy et al., 2008). Another similarity observed in the literature of individuals with BN and restrained eaters is a dissatisfaction with body weight and shape (Lautenbacher et al., 1992; Masheb & Grilo, 2000; Vocks, Legenbauer, & Heil, 2007). Research suggests body dissatisfaction is the strongest predictor of risk of onset of any eating disorder (Stice, Marti, & Durant, 2011). It is thought that the link between body dissatisfaction and disordered eating is mediated by restrained eating and negative affect (the sociocultural dual pathway model of BN; Stice & Shaw, 2002). It could therefore be hypothesised that a dichotomous style of thinking, low self-esteem and dissatisfaction with body weight and shape may increase the risk of experiencing eating disorder symptomology as a result of CR.

_Criticisms of the Restraint Theory_

Whilst the reviewed evidence has been used to supports the theory that CR leads to disinhibited eating, it has been heavily criticised for its methodological flaws and theoretical confusion (Charnock, 1989).
Firstly, the Restraint Scale (RS; Herman & Mack, 1975; Herman & Polivy, 1975) is the most commonly used measurement tool in studies that have supported the restraint theory and questions have been raised concerning its validity (Stice, Sysko, Roberto, & Allison, 2010). Researchers have argued that the high association between ‘dietary restraint’, as measured by the RS, and disinhibited eating is partially due to the inclusion of items on the scale which directly ask about disinhibited or over-eating (e.g. ‘Do you eat sensibly in front of others and make up for it alone?’) (Charnock, 1989; Heatherton, Herman, Polivy, King, & McGree, 1988; Stice, Ozer, & Kees, 1997). Thus the RS measures dieting and over-eating history (The ‘Three-Factor Model’ of dieting behaviour; Lowe, 1993) and is biased towards those who engage in disinhibited eating or ‘failed restraint’ (Heatherton et al., 1988). It has been reasoned that the RS is actually a measure of cognitive restraint, the attempt to eat less than one would like, rather than actual CR through achieving a negative energy balance (Markowitz, Butryn, & Lowe, 2008). This seems likely, since there is no association between those who score highly on the RS and reduced calorie intake (Lowe & Levine, 2005; Stice, Cooper, Schoeller, Tappe, & Lowe, 2007). Few of the studies linking restrained eating to binge-eating included a measure of achieved CR or physiological deprivation, therefore it is uncertain whether any of the participants described as ‘restrained eaters’ were actually in a state of negative energy balance. A study which aimed to explore the counter-regulatory effects in a laboratory setting by substituting the RS for the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien, 1996) and diet status on the day failed to support the restraint theory (Dritschel, Cooper, & Charnock, 1993). Similarly, a longitudinal study using the DEBQ found that dietary restraint did not predict binge-eating behaviours over time (Spoor et al., 2006).
Secondly, with regards to the evidence reviewed as part of this conceptual introduction, researchers have not found increased eating disorder symptoms as a result of experimentally manipulating healthy participant’s calorie consumption through rigorous designs such as RCTs. Much of the evidence used to support the link between dietary restraint and subsequent over-eating comes from prospective studies, which do not rule out the possibility that some third variable (i.e. a confound) has a significant influential role in the association (Stice, Presnell, Groesz, & Shaw, 2005). For example, evidence suggests body dissatisfaction (Johnson & Wardle, 2005) and body shame (Troop, 2016) are likely to influence this relationship. RCTs are the most rigorous way of determining whether a variable is responsible for a particular outcome (Sibbald & Roland, 1998). Therefore, whilst the evidence presented here has demonstrated an association between restriction, whether cognitive or behavioural, and binge eating, without evidence from RCTs it cannot be concluded that CR causes binge eating.

3.2 Literature exploring the beneficial effects of calorie restriction on eating behaviours and mood

Research exploring the psychological impact of CR diets outside of these prospective studies and laboratory experiments contradicts the once widely accepted theory that CR is associated with the development of eating-disorder symptoms (Johnson, Pratt, & Wardle, 2012; Tomiyama, Mann, & Comer, 2009). Since 2003, Stice and colleagues have tested the restraint theory by randomly allocating young adult, female participants who had an interest in dieting either to a low-calorie diet (around 1200 kcal per day) group or a control group for six weeks. Participants who underwent a CR diet lost a significant amount of weight compared to controls and experienced a significant decrease in bulimic symptoms (Groesz & Stice, 2007;
Presnell & Stice, 2003). This evidence suggests that for young adult females, starting a supervised modest CR diet results in beneficial eating disorder related outcomes, rather than negative ones. Since evidence suggests diets rarely result in long term weight loss, another RCT explored the impact of a weight-maintenance intervention on symptoms of BN compared to an assessment only control group. The intervention group maintained their weight and demonstrated significantly reduced risk for obesity onset and weight gain, and, importantly, showed significant decreases in BN symptoms and negative affect, which was not observed in the control group (Stice et al., 2005). It is possible that different results would be observed for diets where calorie restriction is more extreme.

Most recently, during phase one of the CALERIE study, Williamson and colleagues (Redman & Ravussin, 2011; Williamson et al., 2008) measured a number of psychological outcomes at baseline, three months and six months. The experimental groups, each of which demonstrated significant weight loss, reported significantly higher levels of dietary restraint which was not associated with worsening disordered eating cognitions and behaviours or reduced mood. With regards to eating behaviours, participants in the experimental groups reported reduced binge-eating from baseline to three months and again at six months, and reduced disinhibition from baseline to six months. These results were in line with those found by Stice and colleagues. Measures of mood were inconsistent, with one scale demonstrating a reduction in depression whereas one demonstrated no change. Measures of concern about body size and shape reduced from baseline to three months and six months. Similar results were found at phase two; after 24 months of being on the CR diet, participants experienced significant improvements in mood, sexual drive and relationships and reduced tension (Martin et al., 2016). This follow-
up study did not explore the impact of eating disorder symptoms. Whilst this is strong evidence to suggest that moderate CR in overweight, non-obese humans has a beneficial psychological impact and is not a risk-factor for the development of disordered eating, it is important to note the demographics of the participants in the CALERIE research project and thus be mindful of generalising the findings. With 44% being male and with an average age of 38 years, this differs greatly to the adolescent females who are most vulnerable to developing symptoms of eating disorders.

Previous experimental treatment trials have also shown psychological benefits of weight loss interventions for obese and overweight individuals when compared to control groups; results have shown that in addition to significant weight loss, participants show significantly improved quality of life (Rippe et al., 1998) and reduced binge-eating behaviours (Goodrick, Poston, Kimball, Reeves, & Foreyt, 1998). Another RCT which compared dietary interventions against those that promote an ‘undieting’ approach, whereby participants were instructed not to diet and to relearn and recognise how to respond to their bodies’ hunger cues, demonstrated significantly higher weight loss, higher levels of restraint and lower disinhibition scores (Lowe, Foster, Kerzhnerman, Swain, & Wadden, 2001).

The evidence presented here, through a series of RCTs, suggests that starting a CR diet results in a reduction of binge-eating behaviours and does not worsen mood symptoms. Whist this is evidence against the idea that CR results in disinhibited eating as per the restraint theory, it is important to note that participants in these RCTs engaged in successful dietary restraint, as measured by their reduced calorie intake and weight loss. Participants in the CALERIE research project were said to be highly motivated and were provided with all of their meals, some of which
were eaten at the research centre (Di Francesco & de Cabo, 2015). As per the Hawthorne effect, participants are more likely to conform to a diet when it is part of a research study than that of a real-life diet, due to the knowledge that they are being observed (Porta & Last, 2018). Therefore, whilst the RCT design used in these studies increases confidence that the CR diet is responsible for the beneficial outcome, the ecological validity of the studies is compromised. It may therefore be speculated that real-life dieters are at increased risk of dietary slips, which the restraint theory posits are the triggers to disinhibited eating.

3.3 Are intermittent fasting diets a safe and feasible alternative to calorie restriction? Evidence exploring the impact of intermittent fasting on eating disorder and mood symptoms

Whilst research using more rigorous methodology has found beneficial results of daily CR diets on psychological outcomes, in line with the prospective studies and laboratory experiments supporting the restraint theory, there are still concerns that ‘types of unhealthy dieting, such as fasting, increase risk for bulimic pathology’ (Groesz & Stice, 2007, p.60). Thus theorists from the ED field are concerned about the increasing popularity of IF diets. From the research reviewed, there have been no RCTs in which participant’s calorie intake has been experimentally manipulated so that the impact of IF can be systematically explored. Until then, it is uncertain whether IF is a safe alternative method of weight loss to CCR.

Evidence from some less rigorous research studies have suggested a link between IF and eating disorder and mood symptoms. For example, nine healthy, young adult, female participants commenced an IF diet whereby they reduced their calorie intake to below 600 calories per day for four days and ate without restrictions
on three days over a four week period. They demonstrated no weight loss, an increased preoccupation with eating and food, mood deterioration and heightened irritability (Laessle, Platte, Schweiger, & Pirke, 1996). However, the small sample size is a limitation of this study. Evidence from prospective studies suggests that severe CR, as achieved by 24 hours or more of fasting, is a stronger predictor of future binge-eating and BN symptoms, compared to reports of CR in general (Stice, Davis, Miller, & Marti, 2008). Fasting has also been shown to have adverse psychological effects when compared to exercise for weight loss; individuals who engage in fasting regimes have been found to experience significantly greater body dissatisfaction, lower self-esteem, and are more likely to report binge-eating than individuals who engage in rigorous exercise; and individuals who engage in fasting as well as vigorous exercise experience these factors as well as significantly greater thin-ideal internalisation (LePage, Crowther, Harrington, & Engler, 2008). However, causality cannot be deduced from this study.

Further evidence of the adverse effects of IF might be demonstrated by the attrition rates demonstrated in studies exploring CR diets (e.g. Groesz & Stice, 2007; Presnell & Stice, 2003; Seimon et al., 2015). There is evidence to suggest adherence is worse for IF groups compared to CCR groups (Trepanowski et al., 2017). Since it is likely that participants who drop out of research studies do so due to experiencing adverse effects (Moroshko, Brennan, & O’Brien, 2011), this might suggest that the IF regime is less favourable to a CCR regime. This hypothesis has been supported by evidence from an RCT comparing IF to CCR on aspects of physical health, participants in the IF group reported more adverse psychological effects, such as lack of concentration, bad temper and preoccupation with food in comparison to a CCR
group (Harvie et al., 2011); however, these were not measured using standardised assessment tools.

The ‘thrifty genotype’ hypothesis (Neel, Weder, & Julius, 1998) suggests that severe CR alternating with eating without restrictions, as seen in the 5:2 diet, would be linked to disinhibited eating since energy storage has adapted in the context of feast and famine, whereby individuals tend to overeat during times of plenty and store the excess energy as body fat as preparation for times of deprivation. In line with the restraint and abstinence violation effect theories, the way in which an individual appraises their over-eating is likely to impact on their psychological wellbeing and subsequent eating behaviours. However, from the research explored there has been no evidence to support this hypothesis. Rather, a previous thesis exploring the impact of commencing a 5:2 diet in healthy participants demonstrated a reduction in binge-eating and food craving, as well as reduced symptoms of eating disorders in general and adverse mood (Langdon-Daly, 2016). Similarly, a study exploring alternate day fasting (75% CR on ‘fast’ days) in obese participants demonstrated less binge-eating in comparison to prior to starting the diet, as well as a reduction in depression (Hoddy et al., 2015). Whilst these two studies provide evidence against the thrifty gene hypothesis, there were no control groups to compare the results against and thus cannot be confident that the outcomes were due to IF. Nevertheless, data from a qualitative study also demonstrated that IF dieters did not experience heightened levels of hunger, as expected (Griggs, Potter, Rogers, & Brunstrom, 2016) and a review of RCTs comparing IF and CCR suggests that participants experience a ‘carry-over’ effect, whereby individuals spontaneously continue to reduce their calorie intake on non-fast days rather than ‘feasting’ (Harvie & Howell, 2017).
Much research exploring the impact of fasting comes from short-term experimental fasting studies, many of which also demonstrate beneficial psychological outcomes. For example, fasting healthy participants experienced a sense of achievement, pride and control (Watkins & Serpell, 2016), reduced depression (Moreno-Dominguez, Rodríguez-Ruiz, Fernández-Santaella, Ortega-Roldán, & Cepeda-Benito, 2012; Teng et al., 2011), and reduced tension, anger, confusion and total mood disturbance (Hussin, Shahar, Teng, Ngah, & Das, 2013). Furthermore, experimental fasting studies have not observed an increase in binge-eating following fasts (Hetherington, Stoner, Andersen, & Rolls, 2000; Johnstone et al., 2002).

With regards to the benefits of IF over CCR, research suggests that the requirement to monitor one’s calorie intake throughout the day, each day, when engaging in a CCR diet results in preoccupation with food, impaired cognitive performance due to cognitive burden, and reports of guilt and anxiety in response to eating a high calorie food (Jones & Rogers, 2003). Likewise, a study showed that healthy, young females undergoing an IF diet experienced a reduction in positive mood and perceived work performance on fasting days, as accounted for by distraction (Appleton & Baker, 2015). The benefit of IF of the 5:2 type is the short term nature of the CR, and the higher levels of mood and perceived work performance on non-fast days.

**4.0 Overall summary**

In light of the worldwide obesity problem, the development of effective interventions aimed at weight loss and health promotion has been a priority for public health organisations. Numerous dietary modification regimes, such as continuous and intermittent CR, have been developed and readily taken up by the
general population. Whilst there is a great deal of literature exploring the effects of
the diets on markers of physical health, psychological outcomes have received much
less interest. Whilst the restraint theory, based upon evidence collected from
prospective studies and laboratory experiments, suggests that attempted CR leads to
binge-eating, a number of RCTs have demonstrated that this is not necessarily the
case and in fact successful moderate CR can result in a reduction in binge-eating.
However, our understanding of the impact of IF is underdeveloped, as there are
currently no RCTs exploring the psychological outcomes. It is clear from research
and experience of individuals dieting that the vast majority of people will not
develop eating disorder symptomology. Existing literature has identified factors that
are commonly observed in individuals with BN and Polivy and Herman’s ‘restrained
eaters’; low self-esteem, shape and body weight dissatisfaction and a dichotomous
style of thinking. It may therefore be hypothesised that individuals who score highly
in measures of these factors are more at risk of experiencing adverse psychological
consequences of CR and IF.
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Onset of Binge Eating and Bulimic Pathology: A 5-Year Prospective Study.


Part Two: Empirical Paper

Comparing the Effects of Intermittent Fasting and Continuous Calorie Restriction on Eating Disorder and Mood Symptoms in Healthy Dieters
Abstract

**Background:** Overweight and obesity is currently a worldwide problem. Calorie restriction (CR) diets, including intermittent fasting (IF) and continuous calorie restriction (CCR), are popular methods of attempting to lose weight and improve health outcomes. Although research has provided inconsistent results, the eating disorder (ED) field are concerned that CR may lead to adverse psychological outcomes, such as disordered eating symptomology. Few studies have explored the psychological and behavioural effects of IF and whether it differs from the effects of CCR.

**Aims:** To compare the effects of beginning the ‘5:2 diet’, a popular IF regime, with beginning a CCR diet on ED symptoms, binge-eating, food cravings and mood.

**Method:** Males and females participating in either IF (500 calories for females, 650 calories for males 2 days/ week) or CCR (15-25% calorie restriction for 7 days/week) were followed for four weeks. ED symptoms, binge-eating, food cravings, and mood were assessed using online self-report measures prior to starting the diets and after four weeks of dieting (N=86). Participant adherence to the diets was measured through food diaries and weight lost.

**Results:** Participants in both diet groups reported reductions in shape concern, weight concern, binge-eating disorder symptoms, food craving and mood symptoms over the four weeks of dieting. The IF group reported greater reductions in shape and weight concern than the CCR group, and lower levels of eating concern after four weeks of dieting compared to the CCR group. Both groups reported increased restraint scores over the four weeks of dieting, and this was significantly higher for the CCR group. Exploration of risk factors demonstrated those who scored highly on dichotomous thinking experienced less reduction of food cravings for the IF group,
whereas those who scored low on self-esteem experienced a higher reduction of mood symptoms for the CCR group.

**Conclusions:** Commencing an IF or CCR diet was associated with an increase in restraint and a reduction in numerous symptoms of eating disorders, food craving and adverse mood symptoms in healthy adults. Overall, commencing an IF diet was associated with greater reductions in symptoms of eating disorders.
1.0 Introduction

1.1 Background

Overweight and obesity have increased globally over recent decades, and since they are associated with several life-threatening conditions, this presents a major public health concern (Inoue et al., 2018). In response to the increase in mortality and disability observed, individuals with a body mass index (BMI) above that classed as ‘normal’ are encouraged to lose weight through dietary modification (NHS, 2016). Nearly a century of research has explored the effect of calorie restriction (CR) across a range of species, with results suggesting significant reductions in morbidity and mortality (Colman et al., 2009; Fontana et al., 2010a; McDonald & Ramsey, 2010). The first randomised controlled trial (RCT) of CR in healthy, non-obese humans has demonstrated promising results, with participants losing weight and fat mass, and maintaining this over two years (CALERIE; Ravussin et al., 2015). A review of CR in humans concludes that it is a beneficial treatment for obesity and related complications, and ‘most likely exerts additional beneficial health effects even in non-obese individuals’ (Most, Tosti, Redman, & Fontana, 2017 p.43). However, research has also highlighted difficulties with following such a regime, such as an increased desire to eat (Redman & Ravussin, 2011; Williamson et al., 2008).

In more recent years, a form of dietary modification known as intermittent fasting (IF) has captured the interest of both lay individuals hoping to lose weight or stay healthy, as well as researchers and theorists interested in longevity. IF usually involves eating a very low energy diet (VLED, 75-90%) on between one and three days per week, alternating with periods of ad libitum calorie intake on non-restriction days (Harris et al., 2018). The ‘5:2 – Fast Diet’ (Mosley & Spencer, 2013,
2014) is a highly popular form of IF as it allows individuals to eat freely most of the week whilst restricting on any chosen two days. Animal research comparing IF to CCR has demonstrated equally positive results with regards to biological markers of ageing and obesity related disease (Mattson et al., 2017; Varady & Hellerstein, 2007). Recent reviews exploring physiological benefits of IF for humans have also concluded that it is as effective as CCR (Harvie & Howell, 2017; Seimon et al., 2015).

The advocation and resulting popularity of CR, both continuous and intermittent, has raised concerns for researchers, theorists and clinicians working in the eating disorder field. Dieting is considered a key risk factor for the development of eating disorders (Hsu, 1997; Stice, 2016), with evidence from prospective studies suggesting that individuals who engage in dieting behaviours are more likely to develop disordered eating patterns than non-dieters (Halvarsson-Edlund et al., 2008; Neumark-Sztainer et al., 2006, 2011; Stice et al., 2017), and the extreme restriction of IF seems particularly likely to lead to disordered eating. Research exploring the effects of imposed CR during World War II demonstrated a number of adverse psychological effects, including increased binge-eating behaviours once the restriction had ended (Keys, Brozek, Henschel, Mickelsen, & Taylor, 1950; Polivy, Zeitlin, Herman, & Beal, 1994). These findings, alongside evidence that diets rarely result in long term weight loss (Anastasiou et al., 2015; Klesges et al., 1991; Polivy, 1996) triggered a number of theories regarding the association between CR and subsequent binge-eating.

The most common theory linking CR to binge-eating is named the ‘restraint’ theory (Herman & Mack, 1975). It suggests that during a diet, a cognitive rule aimed at restraining one’s calorie intake overrides the physiological pressure to eat. When
the rule is undermined by a situational factor, disinhibited eating is triggered. Research has demonstrated this process by offering individuals a typically high calorie food, such as ice cream, as a pre-load (Herman & Mack, 1975), by showing media images of body image ideals (Boyce & Kuijer, 2014), and by inducing negative mood states such as anxiety (Herman & Polivy, 1975; Polivy, Herman, & McFarlane, 1994) or fear (Cools et al., 1992), and then measuring the subsequent amount of food consumed. The studies demonstrated that participants who scored highly in the restraint scale (RS; Herman & Mack, 1975; Herman & Polivy, 1975), and were thus categorised as ‘restrained eaters’, ate more than those who did not score highly. Furthermore, when restrained eaters were not subjected to a typically high calorie pre-load, they ate less than those who did not score highly.

A cognitive mechanism that has been suggested to explain this phenomenon is based on the Abstinence Violation Effect model (AVE; Marlatt & Gordon, 1985). When an individual makes a causal attribution for breaking a period of abstinence that is internal, stable and global, they are more likely to relapse following a ‘slip’. Conversely, an individual who makes a causal attribution that is specific to that ‘high risk’ situation is more likely to ‘learn from their mistakes’ and regain abstinence (Curry et al., 1987; Mooney et al., 1992). The former type of causal attribution is suggestive of a dichotomous style of thinking, whereby individuals place experiences in one of two categories rather than on a continuum, such as ‘all or nothing’ thinking. Dichotomous thinking styles have been demonstrated in research exploring the eating behaviours of individuals engaging in CR (Herman & Mack, 1975; Mills & Palandra, 2008), obese individuals who regain weight following CR (Byrne, Cooper, & Fairburn, 2003; Byrne, Cooper, & Fairburn, 2004) and also individuals who have a diagnosis of bulimia nervosa (BN; Lethbridge, Watson,
Egan, Street, & Nathan, 2011). The cognitive model of BN (Fairburn, Cooper, & Shafran, 2003) suggests that individuals engage in strict CR in an attempt to enhance their self-worth, which is based on their shape and weight and their ability to control them. Thus, violation of CR is perceived as a personal failure, which triggers a feeling of being out of control and subsequent binge-eating. CR is then reinstated in attempt to regain the lost sense of self-worth. Further similarities between restrained eaters and individuals with BN are low self-esteem (Polivy, Heatherton, & Herman, 1988) and a dissatisfaction with body weight and shape (Lautenbacher et al., 1992; Masheb & Grilo, 2000; Vocks et al., 2007). Prospective analyses of adolescent girls have demonstrated that those scoring highly on measures of body dissatisfaction are more at risk of developing disordered eating behaviours and psychological outcomes (Johnson & Wardle, 2005; Stice et al., 2011).

However, the evidence linking CR to subsequent binge-eating has not been consistent. It has been suggested that many of the studies linking CR to binge-eating were methodologically flawed (Charnock, 1989). Few of the studies included a measure of achieved or actual calorie restraint, instead separating ‘dieters’ from ‘non-dieters’ based on their scores on the Restraint Scale (RS; Herman & Mack, 1975). The RS has not been associated with reduced calorie intake (Lowe & Levine, 2005; Stice, Cooper, Schoeller, Tappe, & Lowe, 2007) and is thought to be biased towards those who have a history of dieting failure. It has therefore been argued that participants labelled as ‘restrained eaters’ are actually unsuccessful dieters, attempting and failing to actually restrict their calorie intake. Furthermore, there have been no RCTs supporting a causal relationship between CR and binge-eating, thus any conclusions of causality are inappropriate. Conversely, more rigorous studies, which have used an RCT design, have found beneficial results on symptoms
of bulimia (Groesz & Stice, 2007; Presnell & Stice, 2003; Stice et al., 2005). The large-scale CALERIE RCT also demonstrated a reduction in binge-eating and concern for body weight and shape, yet measures of mood were inconsistent, demonstrating a reduction in scores of depression on one scale yet no change on another (Redman & Ravussin, 2011; Williamson et al., 2008). A follow up study at 24 months showed improvements in mood, sexual drive and relationships, and reduced tension (Martin et al., 2016).

In light of research demonstrating beneficial results of CR on physical and psychological well-being, whilst acknowledging the difficulties with adherence and compliance, research has more recently started to explore the psychological outcomes experienced by IF dieters. Experimental fasting studies have shown positive effects of short-term (up to 24 hours) water only fasting, such as a sense of achievement, pride and control in healthy women (Watkins & Serpell, 2016), reduced negative mood (Teng et al., 2011), reduced tension, anger, confusion and total mood disturbance in ageing men (Hussin et al., 2013) and reduced negative mood in participants with BN (Moreno-Dominguez et al., 2012). Furthermore, they have not been suggestive of increased binge-eating behaviours (Hetherington et al., 2000; Johnstone et al., 2002). Studies exploring IF specifically have also demonstrated beneficial results on eating disorder symptoms and mood (Hoddy et al., 2015; Langdon-Daly, 2016). Furthermore, whilst research has suggested that eating a high calorie food whilst on a CR diet results in preoccupation with food, impaired cognitive performance, and sometimes guilt and anxiety (Jones & Rogers, 2003), it has been hypothesised that because IF (5:2 type) only requires individuals to control what they eat on two days per week, they will experience these adverse outcomes less regularly.
Since IF is a type of CR, it is hardly surprising that research here is also inconsistent, with some results demonstrating adverse psychological effects of the regime. Healthy participants who engaged in an IF schedule demonstrated psychological outcomes commonly seen in individuals with BN; such as preoccupation with eating and food, mood deterioration and heightened irritability (Laessle et al., 1996). When IF was compared to continuous CR, participants in the IF group reported more adverse, albeit minor, psychological effects, such as lack of concentration, bad temper and preoccupation with food (Harvie et al., 2011).

There have been no RCTs exploring the impact of IF on psychological outcomes, such as eating disorder and mood symptoms. It is therefore unclear whether this is a safe and sustainable form of increasing health and losing weight, or whether it will lead negative outcomes as suggested by the restraint theory. One hypothesis is that the type of CR regime endorsed may affect the likelihood of developing problematic thoughts and behaviours. For example, more extreme CR, such as total fasting for 24 hours, has been shown to be a potent predictor of binge-eating and BN compared to more modest CR (Stice et al., 2008). Another hypothesis is, as well as the type of CR regime itself, certain individual characteristics may act as risk factors for developing eating disorder symptoms following CR. Evidence previously presented has linked body dissatisfaction (Lautenbacher et al., 1992), low self-esteem (Polivy et al., 1988), esteem based on body shape and weight (Fairburn et al., 2003), and a dichotomous style of thinking (Herman & Mack, 1975) with disinhibited eating following CR.

1.2 Aims

The majority of research exploring CR has focused on physiological outcomes rather than psychological ones, thus the impact of the diets on emotional,
cognitive and behavioural outcomes is still very unclear. Furthermore, research exploring the difference between intermittent and daily CR regimes on eating disorder symptomology, to the best of the author’s knowledge, has not been conducted. This current study will therefore aim to answer the following questions:

1. Is commencing the 5:2 - IF diet associated with changes in eating disorders symptoms? Are similar changes associated with commencing a daily CR diet?

2. Is commencing the 5:2 diet associated with changes in food craving and mood, including depression, stress and anxiety? Does this differ to the impact of commencing a daily CR diet?

3. Is commencing either the 5:2 or a CCR diet associated with an increase in eating disorder symptoms in ‘high risk’ individuals?

2.0 Method

2.1 Participants

Participants were recruited between July 2018 and February 2019 through online advertising, social media, posters at the university and word of mouth (see Appendix A for advertising material). Recruitment for this study was undertaken as part of a joint project, see appendix E for further details of this collaboration. Men and women aged 18 years and above, who intended on undertaking either the ‘5:2 – Fast Diet’ or a continuous calorie restriction diet but had not yet started, who had a sufficient level of English language and computer literacy were included in the study. Exclusion criteria were current or history of eating disorders or other diagnosed mental health problems, a diagnosis of moderate-severe intellectual disability, current pregnancy, or with health conditions where medical advice indicates that fasting would potentially endanger health.
The sample size was informed by a previous thesis exploring the effects of IF on eating disorder symptomology (Langdon-Daly, 2016). Langdon-Daly found a reduction in eating disorder symptomology following four weeks of IF in healthy adults, with an effect size of \(d=0.430\). A power calculation was carried out using G Power (Faul, Erdfelder, Lang, & Buchner, 2007), giving an estimated sample size of 46 to provide 80% power with an alpha level of 0.05 and effect size of \(f=0.215\) for a mixed model ANOVA. Given the high attrition rate (54%) experienced in the previous study, the proposed sample size of 46 was increased to 100 to account for the same percentage of attrition in the current study.

### 2.2 Measures

**Primary outcomes: Eating disorder symptomology and binge-eating**

The Eating Disorder Examination Questionnaire (EDE-Q) is a 28-item self-report instrument used to measure Eating disorder symptomology; adapted from the clinical Eating Disorders Examination interview (Fairburn & Beglin, 1994). Respondents are asked to rate items on a six point Likert scale of how often they have engaged in certain eating behaviours over the past four weeks (e.g. ‘Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight?’), from ‘no days – 0’ to ‘every day – 6’. Higher scores reflect higher levels of eating disorder symptoms. The global EDE-Q score can be divided in to four subscales: dietary restraint, weight concern, shape concern and eating concern. The scale also asks participants to list how often they have engaged in binge-eating (described as eating a large amount of food, accompanied by a sense of loss of control over eating), providing an estimate of the frequency of binge-eating episodes. It has been shown to have high reliability (\(\alpha=.74\) to .93) and validity (sensitivity=0.83, specificity=0.96) (Mond, Hay, Rodgers, Owen, & Beumont, 2004;
Rose, Vaewsorn, Rosselli-Navarra, Wilson, & Weissman, 2013). Binge-eating was also assessed using the Binge Eating Disorder Test (BEDT), a 23-item self-report instrument adapted from the BULIT-R bulimia scale (Thelen, Farmer, Wonderlich, & Smith, 1991). Respondents are asked to choose from five possible responses (1-5), which vary for each question. Questions are concerned with binge-eating related thoughts and behaviours over the past four weeks (e.g. ‘I hate the way my body looks after I eat too much’, from ‘seldom or never- 1’ to ‘always-5’). This scale shows high reliability (\(\alpha=.96\)) and validity (sensitivity=1, specificity=1) (Vander Wal, Stein, & Blashill, 2011).

**Secondary outcomes: Food craving and mood**

The State Food Craving Questionnaire (FCQ-S) is a 15-item self-report instrument used to measure food cravings (Cepeda-Benito, Gleaves, Williams, & Erath, 2000). Respondents are asked to rate on a five point Likert scale how strongly they agree with statements concerning craving food at that moment (e.g. ‘I’m craving tasty food’), from ‘strongly disagree-0’ to ‘strongly agree-5’. Higher scores reflect higher levels of food craving. The FCQ-S demonstrates high validity (\(F(1,102) > 11.40, p<.001\)) and reliability (\(\alpha=.96\)).

The Depression, Anxiety and Stress Scale (DASS-21) is a 21-item self-report instrument used to measure depression and low mood, anxiety, and stress and irritability (Lovibond & Lovibond, 1995). Respondents are asked to rate on a four point Likert scale how much the statement applies to them over the past week (e.g. ‘I found it hard to wind down’) from ‘did not apply to me at all – 0’ to ‘applied to me very much or most of the time – 3’. Higher scores reflect higher levels of mood disturbances. The DASS-21 has been shown to be highly reliable (.87 to .94) and
shows good concurrent validity \(r=.68\) to \(.85\) (Antony, Bieling, Cox, Enns, & Swinson, 1998).

*Adherence to diet: food intake*

Participants completed a food diary for one week at baseline and again for the last week of the 28 day diet period (see Appendix B). The food diary asked participants to record everything that they ate or drank, specifying the amount. It is common for individuals to make large errors when estimating food intake (D. A. Anderson, Lundgren, Shapiro, & Paulosky, 2004), frequently under-estimating the number of calories consumed (D. A. Anderson, Williamson, Johnson, & Grieve, 1999). To increase validity and adherence participants were asked to log the amount of food or drink consumed, rather than calories, as soon as possible after consumption. Whilst keeping a food diary has been associated with weight loss (Burke, Wang, & Sevick, 2011), it is recommended by the ‘Fast Diet’ guidance, as well as in other diet guidance, as a means of promoting adherence and is therefore unlikely to impact on the ecological validity of the study.

*Risk factors for ED*

*Weight dissatisfaction and weight suppression.* Participants were asked to state their ideal weight and highest ever weight. This was combined with information about their current weight to calculate their current level of weight suppression (highest ever weight minus current weight; Lowe, 1993) and weight dissatisfaction (current weight minus ideal weight; Mizes, Heffner, Madison, & Varnado-Sullivan, 2004).

*Self-esteem.* The Shape and Weight Based Self Esteem Inventory (SAWBS) is an 11-item self-report instrument used to measure the degree to which someone’s self-esteem is dependent on their body shape and weight (Geller, Johnston, &
Respondents are given a list of attributes (e.g. ‘your body shape and weight’) and are asked to identify and rank which attributes have been important to how they have felt about themselves in the past four weeks, and then quantify their relative importance using a pie chart. This scale has been demonstrated to be reliable (.81) and to have good validity (r=.83). The Rosenberg Self Esteem Scale (SES) is a 11-item self-report instrument used to measure global self-esteem (Rosenberg, 1965). Respondents are asked to rate on a four point Likert scale how strongly they agree with statements concerning their self-esteem (e.g. ‘On the whole, I am satisfied with myself’), from ‘strongly disagree-0’ to ‘strongly agree-3’. This scale has been shown to have good validity (r=.57 to .79) and reliability (α=.91) (Sinclair et al., 2010).

Dichotomous thinking. The Dichotomous Thinking in Eating Disorders Scale is an 11-item self-report instrument used to measure ‘black and white’ thinking in eating-specific and general domains (Byrne, Allen, Dove, Watt, & Nathan, 2008). Respondents are asked to rate items on a four point Likert scale how much the statements (e.g. ‘I think of food as either "good" or "bad’) are true of them over the past month, from ‘not at all true of me -1’ to ‘very true of me – 6’. This scale demonstrates high reliability (α=.88) and has been validated with eating disordered, obese and control populations (r=.41 to .62, p<.01).

2.3 Design and Procedure

A non-equivalent groups, pre-test post-test design was used. Participants had already self-selected their diet regime prior to starting the study.

Following dissemination of advertisements, individuals who contacted the researchers for further information were informed of the inclusion criteria and were emailed a copy of the ‘Information Sheet for Participants’ (see Appendix C). Those
who responded with further interest were emailed a copy of the consent form (see Appendix C) to initial and return and were assigned a unique ID number. As an incentive for participation, all participants were informed that they would be entered in to a prize draw to win online shopping vouchers on completion of the study.

Participants who consented to take part in the study were then asked which diet regime they planned on undertaking and when they planned on starting. Based on the particular diet regime, they were emailed instructions and a flow chart summarising what to expect during the study period (see Appendix C). One week prior to the agreed diet start date, participants were emailed with further instructions containing a link to the online baseline questionnaires (eating disorder symptomology, binge-eating disorder symptoms, food craving, mood and body weight), risk factor variable questionnaires (weight dissatisfaction and suppression, self-esteem, proportion of self-esteem dependent on weight and shape, and dichotomous thinking) and a food diary to complete for the week, whilst eating as usual. All measures were completed using Qualtrics online survey software (Qualtrics, 2019).

Participants then began following their chosen diet regime. The ‘5:2 – Fast Diet’, as described by Mosley and Spencer (2014), required participants to restrict their calorie intake by around 75% of average requirements (500kcal for women; 650kcal for men) on any two ‘fast’ days per week, with no restrictions on the other five days. The CCR diet regime required participants to restrict their calorie intake by between 15-25% of the recommended daily allowance (reducing intake to 1500-1700kcal for women, and to 1875-2125 kcal for men). Participants were encouraged to follow the diet as they would have, had they not been participating in a research study, to allow for naturalistic results.
After five days of undertaking the diet, participants were emailed instructions containing a link to the online ‘week one’ questionnaires (eating disorder symptomology, binge-eating disorder symptoms, food craving, mood and body weight; see Appendix C) and were prompted to complete them by the end of their first week of dieting; if participants were undertaking the 5:2 diet they were instructed to complete the measures on a non-fasting day. This process was repeated for each week of the four weeks. In addition, after the third week of dieting, participants were emailed another food diary to complete for their final week of the study. Once the participants completed their final online questionnaire, they were prompted to return the final food diary.

2.4 Ethics

Ethical approval for the study was obtained from University College London (UCL) Research Ethics Committee (Project ID Number: 12695/001, See Appendix D). Since little is known about the effects of CR on psychological outcomes, individuals who already had the intention of starting a CR diet were recruited and were free to choose which regime they would undertake. Participants disclosing a current or previous eating disorder or other mental health diagnosis, a moderate-severe intellectual disability, or those who were pregnant or had health conditions whereby fasting is unadvisable, such as diabetes, were not included in the study. All participants were provided with a copy of the ‘Information Sheet for Participants’, which included detailed information about the study, including potential risks of the diet. They were advised to adhere to their diet regime as if they were not in a research study, to stop restricting if they began to feel unwell and were informed that they had the right to withdraw from the study at any time, without giving a reason. Participants were given the opportunity to ask questions before providing informed
consent as indicated by their initialling or ticking boxes on the ‘Informed Consent Form’. Participants were assigned a unique identification number which was used to label all measures and food diaries to ensure anonymity and confidentiality of data, whilst allowing for participants to be sent reminders if necessary. Data was stored in line with the Data Protection Act 1998. Participants were not given any specific advice but were encouraged to follow the advice of the particular diet they had chosen to follow.

2.5 Data processing and statistical analysis

Data processing

Data were matched for each participant using their unique ID numbers. Measure totals and subtotals were calculated according to the guidance for each questionnaire. To allow comparison of baseline and week four calorie intake, food diary data was studied for each participant for two randomly selected days for baseline diaries, on one fasting and one non-fasting day for participants in the IF group, and two randomly selected days for participants in the CCR group. Data was processed using the MyFitnessPal website (MyFitnessPal, 2019) to provide an estimate of calories consumed.

Missing data

Where participants completed baseline measures only (n=8, 8.5%), their data was removed from analysis. Reasons for drop out were provided by four participants, as noted in Figure 1. Where participants started the diet, as indicated by completing at least one outcome measure, yet dropped out of the study before the final measures were obtained (n=5, 5.8%), the simple imputation approach, last observation carried forward (LOCF) was used. This type of analysis was used to address the possibility that selective attrition biased the results, as reasons for drop
out indicated that the diet had some adverse effects for three participants. Since LOCF assumes scores for participants who dropped out would remain stable over the time course of the study and thus doesn’t allow for change, results were compared with complete data (completer analysis), as advised by Powney, Williamson, Kirkham, and Kolamunnage-Dona (2014). Due to the significant amount of missing data at various time points, as shown in Figure 1, comparison analysis was completed between baseline and final week only.

Assumptions of normality

Data were subjected to tests of normality to assess adherence to assumptions for parametric testing; histograms were visually inspected, significance of skewness and kurtosis were calculated and Kolmogorov-Smirnov values were checked. For outcome variables where assumptions of normality were not met, square root transformations were attempted. Transformations were retained for the DASS-21, FCQ-S and the EDE-Q restraint, eating concern and binge frequency scores as they improved the distribution of the data; however transformations for the FCQ-S and binge frequency data did not fully meet assumptions of normality. Non-parametric tests were used for baseline comparison for all data that did not meet assumptions of normality, and compared with the results of parametric tests. Outliers, defined as z-scores >3 (Field, 2013) were replaced with scores equivalent to three standard deviations from the mean. However, one case was removed since it was an outlier for all but one of the outcome variables and upon inspection, met criteria for eating disorder symptoms, an exclusion criterion for the study. For main analyses, whereby mixed ANOVAs and ANCOVAs were used, the FCQ-S and binge frequency data were analysed, but should be interpreted with caution.

Comparison of groups, change over time and interactions
The groups were compared according to demographic characteristics, risk factor variables and baseline outcome measure variables using independent sample t-tests and the non-parametric equivalent for continuous data, or chi-square tests for categorical data.

A series of mixed design ANOVAs were used to assess change over time on the outcome variables of EDE-Q global score, EDE-Q restraint score, EDE-Q eating concern score, EDE-Q weight concern score, EDE-Q shape concern score, EDE-Q binge-eating frequency score, BEDT total score, FCS-S total score, and DASS-21 total score, with diet group as the between-subjects variable and time (T1, baseline and T2, week four) as the within-subjects variable. Subscales of the EDE-Q were included as well as EDE-Q global score, due to concerns that restraint items would be expected to increase in those who were dieting, whether or not they actually developed true eating disorder symptoms. ANCOVAs, with baseline scores as covariates, were used to assess differences between the two groups after 28 days of dieting on outcome variables where there were significant differences at baseline.

Analysis of interactions between risk factor variables and outcome variables used repeated measures ANCOVAs, with risk factor scores as the covariates. Where there were any significant interactions, Pearson’s correlations were used to explore the direction of the relationships.

3.0 Results

3.1 Sample Characteristics and Baseline Analyses

A total of 104 participants were recruited for the study, 94 completed baseline measures, and of these 86 (81%) completed measures during the diet. Figure 1 provides an overview of the sample attrition at each stage. One case was
removed due to being an outlier on many measures and due to likely meeting criteria for an eating disorder.

Overall, the average age of participants was 38.2 years old (SD=14.4, range=19-68), with a BMI of 25 (SD=3.73, range=19-37). Of the sample, 77% were female, 61% were white, 1% were Asian and 5% were of mixed heritage. Baseline characteristics of participants in each group are presented in Table 1. There were no significant differences between groups on gender, ethnicity, BMI, global eating disorder score, restraint, shape concern, weight concern and binge frequency (EDE-Q), weight dissatisfaction or suppression, diet history or the self-esteem based on shape and body weight (SAWB). However, age at baseline and self-esteem (RSEI) scores were significantly higher in the IF group, whilst baseline scores on the eating concern (EDE-Q), binge eating disorder test (BEDT), food craving questionnaire (FCQ-S), mood (DASS-21) and dichotomous thinking scale (DTEDS) were significantly higher in the CCR group.
Figure 1. Participant numbers and attrition at each stage.
Table 1. Baseline and risk factor comparisons between IF group and CCR groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>IF $(n=41)$</th>
<th>CCR $(n=44)$</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), mean (SD)</td>
<td>42.41 (15.95)</td>
<td>34.37 (11.73)</td>
<td>t(69)=-2.58, p=0.01*</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>75.6%</td>
<td>77.3%</td>
<td>$X^2(1,85)=0.03$, p=0.86</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>94.9%</td>
<td>93.0%</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0%</td>
<td>2.3%</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>5.1%</td>
<td>4.7%</td>
<td></td>
</tr>
<tr>
<td>BMI mean (SD)</td>
<td>25.05 (3.02)</td>
<td>25.15 (4.31)</td>
<td>t(80)=-0.12, p=0.9</td>
</tr>
<tr>
<td>EDE-Q global mean (SD)</td>
<td>1.59 (1)</td>
<td>1.94 (1.31)</td>
<td>t(80)=-1.4, p=0.18</td>
</tr>
<tr>
<td>EDE-Q restraint mean (SD)</td>
<td>1.02 (0.8)</td>
<td>0.81 (0.62)</td>
<td>t(83)=1.7, p=0.09</td>
</tr>
<tr>
<td>EDE-Q eating concern mean (SD)</td>
<td>0.63 (0.46)</td>
<td>0.92 (0.66)</td>
<td>t(77)=-2.2, p=0.03*</td>
</tr>
<tr>
<td>EDE-Q shape concern mean (SD)</td>
<td>2.4 (1.51)</td>
<td>3 (1.79)</td>
<td>t(83)=-1.7, p=0.1</td>
</tr>
<tr>
<td>EDE-Q weight concern mean (SD)</td>
<td>2.02 (1.26)</td>
<td>2.45 (1.69)</td>
<td>t(79)=-1.3, p=0.19</td>
</tr>
<tr>
<td>EDE-Q binge frequency mean (SD)</td>
<td>0.75 (1.07)</td>
<td>1.19 (1.37)</td>
<td>t(81)=-1.6, p=0.11</td>
</tr>
<tr>
<td>BEDT mean (SD)</td>
<td>41.9 (11.4)</td>
<td>53.1 (15.6)</td>
<td>t(79)=-3.8, p&lt;0.001**</td>
</tr>
<tr>
<td>FCQ-S mean (SD)</td>
<td>5.23 (1.29)</td>
<td>5.95 (1.18)</td>
<td>t(83)=-2.7, p&lt;0.008**</td>
</tr>
<tr>
<td>DASS-21 mean (SD)</td>
<td>2.77 (1.04)</td>
<td>3.34 (1.32)</td>
<td>t(81)=-2.22, p=0.03*</td>
</tr>
<tr>
<td>Weight dissatisfaction mean (SD)</td>
<td>6.25 (3.65)</td>
<td>7.17 (6.33)</td>
<td>t(68)=-0.8, p=0.41</td>
</tr>
<tr>
<td>Weight suppression mean (SD)</td>
<td>3.91 (5.6)</td>
<td>4.81 (4.99)</td>
<td>t(80)=-0.77, p=0.45</td>
</tr>
<tr>
<td>Dieting history (yes)</td>
<td>82.9%</td>
<td>70.5%</td>
<td>$X^2(2,85)=3.3$, p=0.2</td>
</tr>
<tr>
<td>RSEI mean (SD)</td>
<td>31.8 (4.71)</td>
<td>29.12 (5.8)</td>
<td>t(80)=2.3, p&lt;0.02*</td>
</tr>
<tr>
<td>SAWBS mean (SD)</td>
<td>15.49 (11.84)</td>
<td>18.5 (18.16)</td>
<td>t(59)=-0.82, p=0.42</td>
</tr>
<tr>
<td>DTEDS mean (SD)</td>
<td>12.1 (5.29)</td>
<td>14.74 (5.72)</td>
<td>t(80)=-2.16, p=0.03*</td>
</tr>
</tbody>
</table>

NOTE: ** p<0.01, *<p<0.05. There were no differences between the results of parametric and non-parametric analysis. To allow more consistent data reporting, results for parametric tests are reported here.

EDE-Q = Eating disorder examination questionnaire  BDET= Binge eating disorder test  FCQ-S= Food craving questionnaire  DASS-21= Depression, anxiety and stress scale  RSEI= Rosenberg self-esteem inventory  SAWBS = Shape and weight based self-esteem  DTEDS= Dichotomous thinking in eating disorder scale
3.2 Compliance with Diet Protocol

Inspection of food diaries for the IF group (n=26, 63%) showed that 92% (n=24) were compliant to eating <25% of their recommended daily calorie intake on ‘fast’ days, allowing for 5% leeway due to potential measurement error. Participants consumed significantly less calories on fast days in comparison to non-fast days, t(25)=12.2, p<0.001 and baseline, t(25)=9.2, p<0.001. Participants did not eat significantly less calories on non-fast days, in comparison to baseline, t(25)=0.55, p=0.59.

Inspection of food diaries for the CCR group (n=28, 64%) showed that 100% of participants were compliant to eating <85% of their recommended daily calorie intake, allowing for 5% leeway due to potential measurement error. Participants consumed significantly less calories during the diet in comparison to baseline, t(27)=6.96, p<0.001.

Descriptive statistics for weight loss and calorie intake can be found in Table 2.

Table 2. Weight loss and calories consumed before and during the diets for each group

<table>
<thead>
<tr>
<th></th>
<th>IF Mean (SD)</th>
<th>CCR Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss after 4 weeks (kg)</td>
<td>1.44 (1.7)</td>
<td>1.51 (1.6)</td>
</tr>
<tr>
<td>Pre diet day 1 (mean kcal intake)</td>
<td>1901.5 (778)</td>
<td>1790.46 (606.5)</td>
</tr>
<tr>
<td>Pre diet day 2 (mean kcal intake)</td>
<td>1870.5 (644)</td>
<td>1944.46 (525.9)</td>
</tr>
<tr>
<td>Non-Fasting day/ diet day 1 (mean kcal intake)</td>
<td>1812 (608.1)</td>
<td>1202.12 (345)</td>
</tr>
<tr>
<td>Fasting day/ diet day 2 (mean kcal intake)</td>
<td>478.77 (117.5)</td>
<td>1378.68 (357.1)</td>
</tr>
</tbody>
</table>

3.3 Change after 28 days of dieting

_Eating disorder symptomology: global score_
With regards to changes on the EDE-Q global score from baseline to week four, there was a significant main effect of diet group, F(1, 83)=8.9, p<0.005, $\eta_p^2 = 0.1$. There was also a significant interaction effect for time and diet group F(1,83)=31.9, p<0.001, $\eta_p^2 = 0.28$. The completer analysis confirmed a significant main effect of diet group, F(1, 78)=8.1, p<0.05, $\eta_p^2 = 0.1$ and the interaction between time and diet group F(1,78)=35.3, p<0.001, $\eta_p^2 = 0.31$.

As can be seen in Figure 2, participants in the CCR group experienced an increase in eating disorder symptoms after 28 days of the diet. According to a paired samples t-test, this increase in scores was significant, t(43)=-4.1, p<0.001 (CI=-0.55- -0.6) ($d=-0.62$), which was confirmed by completer analysis, t(40)=-4.5, p<0.001 (CI=-0.6- -0.23) ($d=-0.7$). Conversely, participants in the intermittent fasting group experienced a decrease in eating disorder symptoms after 28 days of the diet. According to a paired samples t-test, this decrease in scores was significant, t(40)=3.9, p<0.001 (CI=0.19-0.6) ($d=0.61$), which was confirmed by completer analysis, t(38)=3.9, p<0.001 (CI=0.2-0.6) ($d=0.62$).

![Figure 2. Mean global eating disorder scores at baseline (T1) and week four (T2).](image-url)
*Eating disorder symptomology: restraint score*

With regards to changes on the EDE-Q restraint score from baseline to week four, there was a significant main effect of time, \(F(1, 83)=95.6, \ p<0.001, \ \eta_p^2 = 0.535\). There was also a significant interaction effect for time and diet group \(F(1,83)=41.7, \ p<0.001, \ \eta_p^2 = 0.34\). The completer analysis confirmed a significant main effect of time, \(F(1, 78)=96, \ p<0.001, \ \eta_p^2 = 0.55\), and the interaction between time and group \(F(1,78)=43.5, \ p<0.001, \ \eta_p^2 = 0.36\).

As can be seen in Figure 3, whilst both groups increased in restraint over the 28 days of dieting, the CCR group increased significantly more than the IF group, \(t(83)=-4.8, \ p<0.001 \ (CI=-0.7 - -0.3) \ (d=-4.8)\).

![Figure 3. Mean restraint scores at baseline (T1) and week four (T2).](image)

*Eating disorder symptomology: eating concern score*

With regards to changes on the EDE-Q eating concern score from baseline to week four, there was a significant main effect of diet group, \(F(1, 83)=10.6, \ p<0.01, \ \eta_p^2 = 0.13\).
$\eta_p^2 = 0.114$. There was not a significant interaction effect for time and diet group $F(1,83) = 1.9$, $p = 0.17$, $\eta_p^2 = 0.02$. The completer analysis confirmed significant main effect of diet group, $F(1,78) = 9$, $p < 0.01$, $\eta_p^2 = 0.1$ and a non-significant interaction between time and diet group $F(1,78) = 2.36$, $p = 0.128$, $\eta_p^2 = 0.29$.

As can be seen in Figure 4, the CCR group score remained stable over time, whereas the IF group experienced a reduction in scores of eating concern over time, however, this was not significant, $t(40) = 1.9$, $p = 0.065$ (CI= -0.01 - 0.28) ($d = 0.3$).

When controlling for significant differences at baseline, the difference in eating concern scores after 28 days of dieting was significant between the two groups, $F(1,82) = 9.5$, $p < 0.01$, $\eta_p^2 = 0.1$, as confirmed by completer analysis, $F(1,77) = 9.6$, $p < 0.01$, $\eta_p^2 = 0.1$

Figure 4. Mean eating concern scores at baseline (T1) and week four (T2).

Eating disorder symptomology: shape concern score
With regards to changes on the EDE-Q shape concern score from baseline to week four, there was a significant main effect of diet group, $F(1, 83)=6.9$, $p<0.05$, $\eta_p^2 =0.077$ and time, $F(1,83)= 48.8$, $p<0.001$, $\eta_p^2 = 0.37$. There was also a significant interaction effect for time and diet group $F(1,83)=7$, $p<0.05$, $\eta_p^2 = 0.08$. The completer analysis confirmed the main effect of diet group, $F(1, 78)=6$, $p<0.05$, $\eta_p^2 =0.07$, time, $F(1,83)= 45.7$, $p<0.001$, $\eta_p^2 = 0.37$ and significant interaction between time and diet group $F(1,78)=7.4$, $p<0.05$, $\eta_p^2 = 0.09$.

As can be seen in Figure 5, whilst both groups reported reduced shape concern over 28 days of dieting, the IF group experienced a greater reduction.

![Figure 5. Mean shape concern scores at baseline (T1) and week four (T2).](image)

**Eating disorder symptomology: weight concern score**

With regards to changes on the EDE-Q weight concern score from baseline to week four, there was a significant main effect of diet group, $F(1, 83)=4.5$, $p<0.05$, $\eta_p^2 =0.05$ and time, $F(1,83)= 25.6$, $p<0.001$, $\eta_p^2 = 0.24$. There was also a significant
interaction effect for time and diet group F(1,83)=8.34, p<0.05, $\eta_p^2 = 0.09$. The completer analysis confirmed a significant main effect of diet group, F(1, 78)=4, p<0.05, $\eta_p^2 =0.49$, time, F(1,78)= 22.3, p<0.001, $\eta_p^2 = 0.22$. and interaction between time and diet group F(1,78)=9.5, p<0.01, $\eta_p^2 = 0.12$.

As can be seen in Figure 6, whilst both groups reported reduced weight concern over the 28 days of dieting, the IF group experienced a greater reduction.

**Figure 6. Mean weight concern scores at baseline (T1) and week four (T2).**

**Binge-eating**

With regards to changes on the EDE-Q binge frequency score from baseline to week four, there was a significant main effect of time, F(1,83)=9.2, p<0.005, $\eta_p^2=0.1$, which was confirmed by completer analysis, F(1,78)=6.5, p<0.05, $\eta_p^2=0.07$. There was also a significant main effect of time, F(1,83)=28.4, p<0.001, $\eta_p^2=0.26$ and diet group, F(1, 83)=15.7, p<0.001, $\eta_p^2=0.16$ on the changes in BEDT scores. The completer analysis confirmed the significant main effect of time,
F(1,78)=18.24, p<0.001, $\eta_p^2=0.19$ and diet group, F(1, 78)=14.4, p<0.001, $\eta_p^2=0.16$. There were no significant interactions for time and diet group for binge frequency score, F(1,83)=0.21, p=0.65, $\eta_p^2=0.00$ or the BEDT, F(1,83)=0.04, p=0.84, $\eta_p^2=0.00$, which was confirmed by completer analysis, F(1,78)=0.53, p=0.47, $\eta_p^2=0.01$ and F(1,78)=0.04, p=0.52, $\eta_p^2=0.01$. As can be seen in Figure 7, participants in both diet groups reported reduced binge-eating, as measured by the EDE-Q and the BEDT, over 28 days of dieting.

There was not a significant difference in scores on the BEDT between the two diet groups after 28 days of the diet, when controlling for the significant differences at baseline, F(1,82)=1.54, p=0.22, $\eta_p^2=0.02$. This finding was confirmed by the completer analysis, F(1,77)=1.26, p=0.27, $\eta_p^2=0.02$.

![Figure 7](image.png)

*Figure 7. Mean binge frequency and binge eating disorder test scores at baseline (T1) and week four (T2).*

**Preoccupation with food and food craving**

With regards to changes on the FCQ-S from baseline to week four, there was a significant main effect of time, F(1,83)=16.13, p<0.001, $\eta_p^2=0.16$, and diet group, F(1, 83)=13.34, p=0.001, $\eta_p^2=0.14$. There was not a significant interaction between time and diet group, F(1,83)=0.002, p=0.96, $\eta_p^2=0.00$. The completer analysis
confirmed the significant main effect of time, $F(1,78)=21.1, p<0.001, \eta_p^2=0.2$, and diet group, $F(1, 78)=11.85, p<0.001, \eta_p^2=0.13$, and lack of significant interaction $F(1, 78)=0.4, p=0.85, \eta_p^2=0.00$. As can be seen in Figure 8, participants in both groups reported reduced scores for preoccupation with food and food craving after 28 days of dieting.

There was a significant difference in food craving scores on the FCQ-S between the two diet groups after 28 days of the diet, when controlling for the significant differences at baseline, $F(1, 82)=5.74, p<0.05, \eta_p^2=0.07$. The completer analysis confirmed a significant difference between the two diet groups, $F(1, 77)=6, p<0.05, \eta_p^2 = 0.07$. However, differences between the two groups should be interpreted with caution as the assumption of homogeneity of variance was not met using Levene’s test or variance ratio, thus potentially compromising the accuracy of the $F$-test for group.

![Figure 8. Mean food craving questionnaire score at baseline (T1) and week four (T2).](image)

**Mood**
With regards to changes on the DASS-21 score from baseline to week four, there was a significant main effect of time, $F(1,83)=28, p<0.001, \eta^2=0.25$ and diet group, $F(1, 83)=7.4, p=0.01, \eta^2=0.08$. There was no significant interaction between time and diet group, $F(1,83)=2.2, p=0.14, \eta^2=0.26$. The completer analysis confirmed the significant main effect of time, $F(1,78)=29.7, p<0.001, \eta^2=0.28$, and diet group, $F(1, 78)=5.28, p=0.05, \eta^2=0.06$, and lack of significant interaction, $F(1,78)=2.1, p=0.15, \eta^2=0.03$. As can be seen in Figure 9, participants in both groups reported reduced levels of depression, anxiety and stress after 28 days of dieting.

There was not a significant difference in scores on the DASS-21 between the two diet groups, after 28 days of the diet, when controlling for the significant differences at baseline, $F(1, 82)=2.55, p=0.11, \eta^2=0.03$. This was confirmed by the completer analysis, $F(1,77)=2.4, p=0.13, \eta^2=0.3$.

*Figure 9. Mean depression, anxiety and stress scale score at baseline (T1) and week four (T2).*
Summary

Participants in the intermittent fasting group (IF) reported significant reductions in global eating pathology as measured by the EDE-Q. This was significantly different to participants in the continuous calorie restriction (CCR) group, who reported significant increases in global eating pathology.

Whilst all participants demonstrated reductions in scores on the shape and weight concern subscales, the IF group experienced greater reductions in scores over the 28 days of the diet. Conversely, all participants demonstrated increased scores on the restraint subscale over the 28 days of dieting, which was significantly greater for the CCR group.

There was little change in scores of eating concern for either group over the 28 days, however, the IF group demonstrated significantly less eating concern after 28 days of dieting in comparison to participants in the CCR group.

Whilst there was a significant reduction in preoccupation with food and food craving, as measured by the FCQ-S across both groups, there was also a significant difference between the two groups, which remained significant after controlling for differences at baseline. Inspection of the means for each group suggests that participants in the CCR group (6.5.3) experienced a greater reduction in food craving than participants in the IF group (5.2-4.6).

For binge-eating, as measured by EDE-Q binge-eating frequency score and the BEDT, and mood, as measured by the DASS-21, participants across the whole sample reported significant reductions in their scores over time. There were no significant differences in the change of scores from baseline to week four between the two diet groups, as demonstrated when controlling for baseline differences.
3.4 Relationships between risk factors and eating disorder/mood symptoms

IF group

There was a significant interaction between the dichotomous thinking in eating disorders and change in food craving on the FCQ-S, which was confirmed by the completer analysis, \( F(1, 35)=7.1, p<0.05, \eta^2_p = 0.17 \). Further exploration of this association using Pearson’s correlations showed that greater dichotomous thinking was negatively correlated with a reduction in food craving \((r(39)=-0.39, p<0.01)\). There were no other significant interactions.

CCR group

There was a significant interaction between self-esteem on the RSEI and change in depression, anxiety and stress on the DASS-21, which was confirmed by the completer analysis, \( F(1, 38)=8.1, p<0.01, \eta^2_p = 0.18 \). Further exploration of this association using Pearson’s correlations showed that greater self-esteem was negatively correlated with a reduction in depression, anxiety and stress \((r(43)=-0.42, p<0.01)\). There were no other significant interactions.

Summary

In the IF group, only one risk factor for disordered eating, dichotomous thinking in eating, demonstrated a significant interaction with an outcome variable, food craving. Results showed that scoring high in dichotomous thinking was related to less reduction in food craving after 28 days of following the 5:2 diet.

In the CCR group, only one risk factor for disordered eating, self-esteem, demonstrated a significant interaction with an outcome variable, mood. Results showed that scoring high in self-esteem was related to less reduction in depression, anxiety and stress after 28 days of following a CCR diet.
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NOTE: *p<0.05

IF= Intermittent fasting  CCR= Continuous calorie restriction  EDE-Q = Eating disorder examination questionnaire  BEDT= Binge eating disorder test  FCQ-S= Food craving questionnaire  DASS-21= Depression, anxiety and stress scale  RSEI= Rosenberg self-esteem inventory  SAWBS = Shape and weight based self-esteem  DTEDS= Dichotomous thinking in eating disorder scale

4.0 Discussion

4.1 Main findings

Demographics

On average, participants in the IF group were significantly older than participants in the CCR group. This finding is in line with a previous study exploring differences between dieters who have self-selected either the IF or CCR regime (Teng, 2015). It might suggest that a diet claiming to improve health and increase longevity by preventing age-related diseases and functional decline, such as the 5:2 diet, is more attractive to an older age group. However, few studies have explored the differences between individuals who have self-selected either an IF or CCR diet, thus this explanation is highly speculative. There were no significant differences between the two groups with regards to any other demographic; participants in both groups were mostly white females, had a mean BMI around 25, and most had previously dieted.
Adherence to diet regime

Participants in the IF and CCR groups lost an average of 1.44 kg and 1.51 kg, respectively, over the 28 days of dieting. These weight losses are similar to what might be expected, based on previous findings (e.g. Hoddy et al., 2015; Laessle et al., 1996; Langdon-Daly, 2016). Exploration of the available food diaries \( n=54, 64\% \) demonstrated a high compliance rate in the IF group and a full compliance rate in the CCR group. Whilst self-reports of calorie intake are often inaccurate (Livingstone et al., 1990), with individuals tending to underestimate actual intake (de Castro, 2000), the combination of the food diaries with the weight losses are suggestive of participants being in a state of negative energy balance during the diets. The reasons for 36% of participants not returning their food diaries is unknown. It might be speculated that such participants experienced difficulty adhering to the CR regimes, and thus tentative conclusions should be drawn regarding the impact of attempting to follow and self-reported following of the IF and CCR diets. However, using food diaries is an improvement on previous studies exploring the link between CR and eating disorder symptomology, which have often used weight loss alone as an indicator of adherence (e.g. Presnell & Stice, 2003).

Information gathered from the food diaries suggests that participants in the IF group did not consume less calories on non-fasting days in comparison to baseline and thus did not experience a ‘carry-over’ effect in response to commencing the 5:2 diet, as demonstrated in previous research (Harvie & Howell, 2017).

Primary outcomes

The primary aim of the current study was to explore the effects of an IF diet on symptoms of eating disorders and binge-eating in healthy participants, in comparison to a CCR diet. The IF group reported a reduction in global symptoms of
eating disorders, whereas the CCR group reported an increase. Analysis of the individual subscales demonstrated an increase in restraint for both groups, however, this was higher in the CCR group. Conversely, whilst both groups demonstrated a reduction in shape and weight concern, this was higher for the IF group. The IF group also reported less eating concern compared to the CCR group after 28 days of dieting. There were no significant differences between the reported reductions in frequency of binge-eating and symptoms of binge-eating disorder.

*Eating disorder symptomology.* The finding that IF resulted in reduced symptoms of eating disorders was consistent with previous research exploring the effects of IF on psychological outcomes (Hoddy et al., 2015; Langdon-Daly, 2016) and thus provides further support of beneficial outcomes of commencing a short-term IF diet.

The additional finding that the CCR group resulted in an increase in global symptoms of eating disorder is in line with an unpublished thesis, which found higher levels of eating disorder pathology, as measured by the EDE-Q, in participants who had been following a CCR diet regime for over four weeks, compared to participants who had been following an IF diet regime for over four weeks (Teng, 2015). Considering the reduction in shape and weight concern and the lack of change in eating concern, this finding is likely a result of the greater increase in the restraint score in the CCR group. This subscale asked participants to state how many days they have limited their food intake (e.g. ‘Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?’), and since the CCR diet requires the participant to restrict seven days per week it is not surprising participants in this group reported increased scores in this measure compared to baseline and in comparison to
participants in the IF group, who are only required to restrict for two days per week. Focusing on the results of the EDE-Q subscales, the finding that participants in the CCR group reported an increase in restraint and a reduction in some symptoms of eating disorders is line with findings from the large scale CALERIE research trial (Williamson et al., 2008). This study also demonstrated an increase in restraint, as expected, alongside reductions in a number of eating disorder symptoms, including concerns about body size and shape.

The finding that the IF group reported greater reductions in shape and weight concern over 28 days, and less eating concern than the CCR group after 28 days of dieting is novel. Theories such as the restraint theory and abstinence violation effect might lead one to expect participants in the IF group to be more likely to experience increases in symptoms of eating disorders rather than a greater decrease. IF involves a disruption of the cognitive rule that governs the fast day to allow for ‘feasting’ on non-fast days, which according to the theories, might trigger disinhibited eating. However, RCTs have not found evidence to support such theories. Alternatively, it could be hypothesised that the IF group experienced greater beneficial results due to the flexibility of the 5:2 diet. With dieters being free to eat as they like on most days of the week, free to choose which days they wish to ‘fast’, and also free to swap their fast day at last minute if it proves too difficult that day.

*Frequency of binge-eating and symptoms of binge-eating disorder.* The current findings do not support the theory that binge-eating is triggered by CR (e.g. Restraint Theory, Herman & Mack, 1975), as demonstrated by evidence from as long ago as World War II (Keys et al., 1950; Polivy et al., 1994) and the host of prospective studies and laboratory experiments (e.g. Herman & Mack, 1975; Herman & Polivy, 1975). Instead, the finding that the CCR diet resulted in reductions in
frequency of binge-eating and symptoms of binge-eating disorder support findings from more rigorous studies, which demonstrate individuals experiencing a reduction in symptoms of bulimia nervosa (Groesz & Stice, 2007; Presnell & Stice, 2003; Stice et al., 2005) and binge-eating (Redman & Ravussin, 2011; Williamson et al., 2008) following random allocation to a CCR diet. Whilst less has been published about the effects of IF diets on symptoms of disordered eating, these findings are also in line with results demonstrating that IF reduces self-reported binge-eating (Hoddy et al., 2015; Langdon-Daly, 2016). Furthermore, information from the food diaries demonstrates that participants in the CCR group consumed significantly fewer calories during the diet period in comparison to baseline, and participants in the IF group consumed significantly fewer calories on a fast day in comparison to baseline and did not consume a significantly different quantity of calories on their non-fast day in comparison to baseline. This supports the finding that participants did not engage in binge-eating behaviours and in fact experienced a calorie deficit whilst on either diet.

Whilst this study did not utilise an RCT design, it used a naturalistic design to compare participants with different patterns of calorie intake and is therefore methodologically similar to the previous studies that these results are in line. These findings therefore are consistent with the view that data collected from studies using the Restraint Scale to separate ‘restrained eaters’ from ‘unrestrained eaters’ are not measuring eating behaviours of participants who are engaging in actual calorie restraint, more so the behaviours of participants who have a history of unsuccessful dieting (Presnell & Stice, 2003).

An alternative possible explanation for the contradictory findings is regarding the Hawthorne effect, which suggests participants in a research study modify their
behaviour in line with what they think is expected of them (Porta & Last, 2018).

Therefore participants following a CR regime as part of a research trial, such as this, may not be representative of individuals following a non-supervised, real world diet. It is likely that levels of motivation to adhere to the diet differ between the two types of dieters, as hypothesised to be the case in the CALERIE research trial (Di Francesco & de Cabo, 2015). Furthermore, participants in this study were sent weekly emails for data collection, which likely acted as a reminder to adhere to their diet protocol, something most dieters in the real world would not receive.

Secondary outcomes

The second aim of the current study was to explore the effects of an IF diet on preoccupation with food and eating and food craving, and also mood, including depression, anxiety and stress, in comparison to a CCR diet. Somewhat surprisingly, participants in both groups reported reductions in preoccupation with food and food craving, and a reduction in adverse mood states. The CCR group demonstrated a greater reduction in scores of preoccupation with food and food craving after 28 days of dieting, in comparison to the IF group.

Preoccupation with food and eating and food craving. Previous findings have demonstrated an increase in thoughts about food and eating for overweight individuals following an IF regime at 6 months (Harvie et al., 2011), for healthy individuals following an IF regime at 1 month (Laessle et al., 1996), and overweight individuals following a CCR regime at six (Redman & Ravussin, 2011) and 12 months (Williamson et al., 2008). Surprisingly, these findings were not replicated in the current study. With regards to the CCR group, the current findings may reflect a difference in the sample; most previous studies recruited overweight and obese participants whereas the current study recruited participants with normal BMIs as
well as those with BMIs in the overweight/obese range. With regards to the IF group, the findings were in line with a previous thesis (Langdon-Daly, 2016), which used a similar design and the same measure of food cravings.

*Mood*. Participants in both the IF and the CCR groups reported reduced depression, anxiety and stress over the 28 day period of dieting. Previous evidence has also suggested beneficial effects of a CR diet on mood and reduced tension (Martin et al., 2016) and of an IF diet on mood (Hoddy et al., 2015; Langdon-Daly, 2016). There were no differences between the two groups in the amount of improvement, which is in line with a previous retrospective comparison of individuals following the two diets on mood (Teng, 2015). These results, in combination with previous findings, suggest that restricting calorie intake, either daily or intermittently, reduces negative mood states perhaps through providing a sense of accomplishment, pride and control (Watkins & Serpell, 2016).

*Relationships between risk factors and eating disorder symptoms and mood*

The final aim of the current study was to explore whether scores on certain risk factors for eating disorders impacted on the change in outcomes over the 28 day period of dieting for both the IF and the CCR group. Results demonstrated that dichotomous thinking in eating was negatively correlated with a reduction in food craving for participants in the IF group. This suggests that those who have a dichotomous thinking style are less likely to experience reductions in food craving during the diet period compared to participants with a less dichotomous style of thinking. These results could be considered to be in line with previous findings linking dichotomous thinking to weight regain following dieting in obesity (Byrne et al., 2003; Byrne et al., 2004), since continued food craving and preoccupation with food and eating is likely to impact on adherence to dieting.
This study also found that a reduction in mood was negatively correlated with self-esteem for participants in the CCR group. Thus individuals with low self-esteem are more likely to experience reductions in negative mood states during the diet period. Conversely, individuals with higher self-esteem are less likely to experience a change in their emotional wellbeing during the diet. Based on research by Polivy and colleagues (Polivy et al., 1988), it was expected that participants scoring higher in risk factors for eating disorders (e.g. low self-esteem) would be more likely to experience adverse consequences as a result of CR (Polivy et al., 1988). These differences in findings may represent the methodological differences between the current study and that of Polivy and colleagues, since evidence suggesting a link between risk factors such as low self-esteem, restrained eaters and disinhibited eating do not include a measure of actual CR and therefore it is uncertain whether participants in such studies are actually reducing their calorie intake.

4.2 Limitations

The interpretation and generalisability of the study’s findings are limited by the homogeneity of the current sample, being predominantly white females who have dieted before. Whilst evidence does suggest white females are more likely to engage in diets than other groups (Hill, 2002), a substantial number of men (Slof-Op ’t Landt et al., 2017) and BME individuals (Liechty & Lee, 2013) also engage in dieting behaviours and these groups are underrepresented in the current study and in much of the dieting literature.

For ethical reasons participants were self-initiated dieters who had chosen to either complete the 5:2 or a daily reduced calorie diet, and thus groups were not randomised. Results demonstrated significant differences at baseline, with the CCR
group scoring higher in some risk factors and outcome measures. Whilst there were attempts to account for these differences in the analysis, it is likely that the final scores reflected some pre-existing differences between the two groups.

Finally, the length of study could be considered a limitation of this research. Due to high dropout rates in existing research exploring CR (e.g. Harvie et al., 2011), and the practical constraints of the DClinPsy, a period of 28 days was chosen to increase adherence to completing questionnaires. However, research exploring dieting and subsequent eating behaviours frequently demonstrates that weight is lost and then regained, which suggests binge-eating occurs following termination of dieting. It therefore would be helpful for future research to include follow up questionnaires over a longer time period. This would have the potential to provide data about symptoms of eating disorders and binge-eating which may occur either after longer on the diet, or once the participant had chosen to stop dieting and had received less contact with the researcher. Such amendments would attempt to bridge the gap between those studies which manipulate calorie intake through quasi-experimental designs such as this and previous RCTs, and the methodology utilised by Polivy and colleagues to enhance quality of research whilst retaining ecological validity.

4.3 Implications

Clinical implications

In light of the increase in overweight and obesity, which are implicated in a number of life-threatening conditions, it is a public health priority to develop safe and effective methods of weight loss. Whilst the majority of research exploring CR has focused on the physiological benefits of the regimes, the current study has provided an insight into the psychological implications of IF and CCR. This study
suggests that healthy adults may be able to use IF and CCR to achieve and maintain a healthy body weight without experiencing adverse psychological and behavioural consequences.

**Further research**

Future research comparing the psychological outcomes of continuous and intermittent CR diets should address the limitations of this study. A priority would be to involve a follow up period to allow for collection of data across a greater timescale. The CALERIE research trial found that beneficial differences in psychological outcomes from 6 months of a CR diet were maintained over a 6 month follow up period. It is necessary to repeat this for IF to allow for stronger conclusions regarding the safety and potential benefits and risks of this diet regime.

Secondly, it would be beneficial for further research to take place on a larger scale. Firstly, this would likely increase the variability in participant characteristics, including participants from under-represented groups in research on dieting, such as men and those who have no history of dieting, participants of different ethnicities and from different locations. Secondly, a larger scale study would allow for more detailed analysis. This would allow for further exploration of the increased benefits of IF over CCR, and may help to explain why CR diets lead to bingeing and disordered eating for some people but not others.

**4.4 Conclusions**

Starting the 5:2 diet (IF) was associated with greater reductions in shape and weight concern than starting a daily reduced calorie diet (CCR). It was associated with similar reductions in binge-eating and negative mood states and smaller reductions in preoccupation with food and food craving. Scoring highly on dichotomous thinking, a risk factor for disordered eating was associated with a
reduction in the beneficial effects of the 5:2 diet on food craving scores. Conversely, scoring low on self-esteem was associated with an increase in the beneficial effects of CCR on negative mood states. These findings have the potential to contribute to a body of research which may help individuals hoping to lose weight and improve their health to choose whether the 5:2 regime is an appropriate diet for them.
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Part three: Critical appraisal
1.0 Introduction

This critical appraisal will reflect on the processes involved in carrying out the current research project. Firstly, the choice of topic will be discussed in the context of both my personal and professional experiences. Learnings taken from the experience of writing the conceptual introduction will be reflected upon briefly, particularly with regards to how they influenced decision-making for the research project. I will discuss the strengths and limitations of the research design within the context of a doctoral research project. Finally, I will reflect upon the learning outcomes, both professional and personal.

2.0 Choice of topic

2.1 The Cost of Eating disorders

Whilst eating disorders are relatively rare amongst the general population, the consequences and cost to life and the economy are highly concerning. All of the eating disorders carry an increased risk of mortality (Smink, Van Hoeken, & Hoek, 2012) and, alongside substance misuse, pose the highest risk of premature death from both natural and unnatural causes out of all the psychiatric conditions (Harris & Barraclough, 1998). Growing up, I was part of a competitively successful hockey team, in which difficulties with eating and exercise were not uncommon. A number of my team mates required the support of professional services, and this experience ultimately brought home the reality of premature death as a result of anorexia nervosa. The association between eating disorders and mortality kick-started my motivation to peruse a career in clinical psychology.

Eating disorders are commonly understood to be serious and difficult to treat psychiatric conditions (Fassino & Abbate-Daga, 2013; Klump, Bulik, Kaye, Treasure, & Tyson, 2009), with evidence demonstrating that the higher the severity
and the longer the duration of the condition, the poorer the prognosis (Keel & Brown, 2010). Prior to starting training, I gained varied experience working with individuals with eating disorders, from an inpatient setting to a community support group. The value given to some of the symptoms of eating disorders, particularly restriction, was striking. Individuals, especially those who were inpatients, frequently discussed a feeling of pride and superiority in comparison to peers, usually in response to succeeding in controlling calorie intake when others did not. Similarly, it was not exceptional to hear individuals describe the comfort brought by binge-eating when they otherwise felt very low in mood, likening it to ‘receiving a hug’. Research has demonstrated that some eating disorders are maintained by positive reinforcement, such as sense of control and pride (Serpell, Treasure, Teasdale, & Sullivan, 1999). These characteristics were often experienced as highly challenging for the professionals I worked with. It was interesting to hear that this ‘resistance to change’ (Vitousek, Watson, & Wilson, 1998) influenced some colleagues to avoid working with this clinical population.

Furthermore, in a time of financial difficulty for public services, it is important to note that eating disorders are associated with highly elevated economic costs (Mitchell et al., 2009). Annual health care costs for individuals with eating disorders are significantly higher than those for individuals without an eating disorder (Samnailiev, Noh, Sonneville, & Austin, 2015). Given that eating disorders are difficult to treat, can result in life-threatening conditions and place a huge burden on society, I felt it was vital to carry out research exploring potential precipitating factors, such as dieting.
2.2 Dieting

Informed by research suggesting that dieting is a key risk factor in the development of eating disorders (Hsu, 1997), as well as personal experience witnessing temporary diets extend in to a chronic battle for calorie restriction entwined with uncontrolled eating, an initial underlying assumption was that this research project would demonstrate harmful effects of calorie restriction. The ‘5:2 Fast Diet’ (Mosley & Spencer, 2014) had quickly become popular on a global level, family members and friends alike were practicing it with varying results on both their body weight and mood. The BBC documentary ‘Eat, Fast and Live Longer’ advised that this was a way of eating that could increase your lifespan and help you lose weight whilst still being able to eat whatever you want. Thinking about the superficial similarities between the 5:2 diet and eating behaviours characteristic of bulimia nervosa, it was questionable whether it was responsible for a qualified doctor to be advocating such a diet regime on prime time television, especially in light of the lack of research on human participants. Whilst a previous UCL thesis exploring the impact of the 5:2 diet on psychological outcomes found improvements in eating disorder symptomology and mood (Langdon-Daly, 2016), the large attrition rate experienced in said study gave reason to question whether those participants who dropped out experienced adverse effects, which were not captured in the results.

As previously mentioned, eating disorders are relatively rare in the general population, however, the majority of individuals will engage in a form of dietary modification at some point in their lives. Thus it was clear that this research project needed to explore certain characteristics or risk factors that may increase the likelihood of experiencing adverse psychological effects after starting the diet.
3.0 Conceptual introduction

In carrying out a detailed literature review for the conceptual introduction, I improved my understanding of the different types of calorie restriction and the associated benefits for health and ageing in animals and potentially humans, based on years of research with varied methodological designs. It was clear from the literature that evidencing the positive effects of calorie restriction on health was the priority, and understanding the psychological effects was usually explored later (Williamson et al., 2008), briefly as a secondary outcome (Harvie et al., 2011) or not at all. Despite this, I learnt a great deal about the existing research and theories regarding restrained eating, including calorie restriction specifically, and symptoms of eating disorders, most notably binge-eating disorder. On reflection, I was struck by the inconsistency of findings by different groups of researchers. Whilst Polivy, Herman and colleagues (e.g. Polivy & Herman, 1985) had provided a wealth of evidence to support the theory that dieting causes disordered eating, particularly binge-eating, many other researchers had disputed these claims with contradictory evidence (e.g. Groesz & Stice, 2007). Bearing in mind the context of which calorie restriction has been developed and promoted, these findings would have drastically different implications for both individuals experiencing difficulty with overweight and obesity and those with disordered eating. It was therefore important for me to take a critical approach when reviewing the literature to understand why these studies, which claimed to be exploring something similar, had entirely different outcomes.

The process of completing the conceptual introduction was incredibly helpful with regards to learning outcomes and influenced the position I took in beginning the current research project. Firstly, it highlighted the error in making generalised
assumptions based on specific clinical and personal experiences and a limited knowledge of the evidence base. I therefore questioned my initial assumption that this research project would demonstrate adverse effects of the 5:2 diet, and took a more curious approach, with research questions rather than hypotheses.

Furthermore, this process highlighted the importance of taking a critical approach when drawing upon research. There were a number of criticisms regarding the work of Polivy, Herman and colleagues, particularly concerning their methodological approach to identifying and grouping restrained and non-restrained eaters. Through reading a great deal of literature exploring dieting behaviours, I developed a better understanding of the different ways previous studies had operationalised CR. This was particularly helpful to know and reflect upon when designing the current research project; it appeared that calorie counting and measurement of weight loss were thought to be the most valid methods as opposed to use of a ‘restraint’ measure.

4.0 Empirical paper

4.1 Research design

Randomised controlled trials (RCT) are considered to be the most powerful experimental designs, since they reduce the likelihood of alternative explanations (e.g. confounding variables) and increase confidence in the cause and effect relationship (Simon, 2015). The literature review for the conceptual introduction highlighted fundamental differences in the findings demonstrated by studies that randomly allocated participants to either an experimental diet group or control group (e.g. Presnell & Stice, 2003) and studies that utilised a prospective design (e.g. Polivy, Herman, & McFarlane, 1994). Critics claimed that findings produced by studies whereby participants were allocated to a ‘restrained eaters’ or ‘non-restrained
eaters’ group based on their scores on measures such as the Restraint Scale (Herman & Mack, 1975) were not valid, as the scales were a measures of historical unsuccessful dieting rather than current dieting behaviour through calorie restriction (Charnock, 1989). Because the current study aimed to explore the effects of starting a diet, it was clear that a prospective design using a ‘restraint’ scale would not have been appropriate. However, after consideration of adopting the RCT design, it was felt that for this research project, its limitations were greater than the scientific benefits. Firstly, RCTs are often costly and time consuming (Barker, Pistrang, & Elliott, 2016), resources that were not available to me given it was part of a doctoral research project. They do not take account of participant choice, and therefore a participant may have been assigned a diet that they knew they would not like, which may have impacted on their adherence and thus likely affected the results of the study. Finally, and what seemed most pertinent, it was felt that assigning participants to the 5:2 diet would have been unethical since my initial assumption was that it may lead to greater adverse psychological outcomes. As an alternative to RCTs, non-equivalent groups pre-test-post-test design are commonly used in psychological research (Barker et al., 2016; Coolican, 2009). This type of design allowed for recruitment of participants who had already chosen to start either a 5:2 (IF) or daily reduced calorie (CCR) diet, thus avoiding the ethical problems mentioned previously. The drawback of this type of design allowed for the two groups to differ systematically in ways other than the experimental group they were assigned to. For example, individuals with pre-existing symptoms of eating disorders or binge-eating may have been more likely to choose one diet over the other, thus the results would have been impacted by these pre-existing group differences in addition to the experience of starting the diet.
In fact, upon starting data analysis, results demonstrated a significant difference between the two groups, with the CCR group scoring significantly higher in a range of risk factors and outcome variables prior to starting the diet. Whilst statistical analysis (e.g. analysis of covariance) assisted in controlling for these differences at baseline, other variables that may have impacted on the difference between the two groups were not controlled for and thus likely impacted on the validity of the results.

In addition, it is important to note that the current study aimed to expand upon the previous thesis (Langdon-Daly, 2016) and thus a similar design was used.

4.2 Participant recruitment

Recruiting participants who were planning on starting either the 5:2 or a CCR diet but had not yet done so presented as a challenging and lengthy process. The previous thesis, which recruited individuals who intended to begin the 5:2 diet but had not yet done so, used social media to target famous personalities linked to the diet, most notably Michael Mosley. This proved highly effective, as they initially recruited 176 participants with ‘rapidity’ and ‘ease’, from six different continents. I took advantage of my insight into their recruitment strategy, and instantly reached out to the same celebrities, forums, and websites and others that I could think of, through various social media platforms and email. However, I experienced considerably less success. I received no response from either of the authors of the ‘Fast Diet’, despite numerous attempts. On reflection, the previous thesis was completed in 2016, thus recruitment began less than four years following the BBC documentary and less than two years after the second edition of the ‘Fast Diet’ book (Mosley & Spencer, 2014) was published. Since then, Mosley had turned his attention to a different CR diet, ‘The 8 weight Blood Sugar Diet’ (Mosley & Taylor,
2015) and thus it was likely that he was less motivated to support research in to the 5:2 diet. Additionally, I found it difficult to know where to begin in targeting potential participants for the CCR diet, since there was no diet brand as there is for diets such as the ‘Fast diet’, ‘Atkins’, ‘Weight Watchers’ and ‘Slimming World’.

Based on the success of the previous thesis, the expected recruitment period of six months increased to ten months. Whilst the previous thesis had also been able to share the recruitment process with a fellow trainee as part of a joint thesis, the participants I required for this project differed from my colleague’s, despite it also being set up as a joint thesis. Finally, 94 participants were recruited, most of which were a result of persistently targeting dieting groups and broadcasting messages on social media, as well as word of mouth. This meant that, unlike the previous study, I did not have a large international demographic.

Fortunately, the current study did not experience the same level of attrition as the previous thesis, which was something that I was mindful of from the beginning. I aimed to design the study so that I would have collected outcome data for participants who stopped dieting before the 28 days were finished. I thought that it was important for the results to reflect the psychological outcomes of participants who did not wish to continue their diet, as well as those who did, so that the results could be generalised to a broader population rather than only ‘successful dieters’. Collection of outcome measures on a weekly basis meant participants who had completed at least one week of measures could be included. However, data from the eight participants who completed baseline only was unfortunately lost. Ultimately, only five participants stopped completing the outcome measures after week one. On reflection, the weekly emails to participants likely acted as a motivator to keep
adhering to their diet regime. Whilst this reduced the likelihood of attrition, it may have impacted on the generalisability of the results of this study.

Efforts were made to exclude individuals who reported a current or historical eating disorder from the study. This decision was based on ethical reasons, as it would not be appropriate to encourage dieting for this population. Since a large proportion of the sample had dieted before and had thus far not developed a clinical level of disordered eating or symptoms of binge-eating, it may mean that the participants in this sample were representative of individuals who diet without experiencing adverse consequences. One case was deleted from the study due to scoring in the eating disorder range in baseline outcome measures, and the participant was emailed with advice to visit their GP. I found this process difficult for a number of reasons. I noticed myself hypothesising about why the individual might have participated in the research project, and wondered whether it had been a call for help. As a trainee clinical psychologist, it felt uncomfortable to send an email highlighting to this person that their behaviour was concerning, and only offering a link to an eating disorder charity website and advice to visit their GP.

4.3 Data collection

Online data collection was used with the intention of making participation as easy and accessible as possible. However, asking participants to complete five questionnaires, some of which were lengthy, on a weekly basis for five weeks was, on reflection, a lot to ask. Some participants provided feedback that questionnaires felt repetitive, and there was a lot of missing data in between week one to week three. As a result of the amount of missing data, I was not able to use statistical analysis that included all time points (e.g. 5x2 mixed design ANOVA), which would have allowed for a more detailed understanding of the effect of the CR regimes over
the four weeks. Whilst weekly data collection allowed for a simple imputation approach to missing data (LOCF), I regret that it was not used to its full potential, especially given the time and effort afforded by the participants.

Had this not been a Doctoral research project, and I had more time and finances for the study, I think it would have beneficial to ask participants to complete follow-up questionnaires one month after the CR diet period had ended. Participants would have been advised to either stop or continue the CR as they wish but to complete the follow-up questionnaires regardless. This would have provided an opportunity to explore the psychological effects of CR in a more naturalistic way. A likely difficulty of this would be level of attrition, which is why I think it would be necessary to thank participants financially.

4.4 Findings

The results from the IF group in the current study replicated those of the previous thesis (Langdon-Daly, 2016). The author reflected in their critical appraisal that they felt highly surprised by these results, due to previous evidence demonstrating an association between dieting and disordered eating, particularly binge-eating. It was questioned whether the high attrition rate and lack of control group may in part explain these findings. However, the current study did not suffer from these limitations, and thus provides support of the psychological benefits associated with commencing and being on an IF diet.

The results from the CCR group demonstrated a significant increase in global symptoms of eating disorders, which was somewhat a surprise in the context of the overall findings of the study as well as previous research findings. A number of possible explanations were considered, for example, perhaps the IF regime has unique beneficial qualities with regards to eating disorder symptoms due to the
flexibility of the regime, or perhaps it was due to the methodological differences between the current study and previous research, such as the shorter diet period and non-randomisation of groups. However, it was felt to be most likely a result of using the Eating Disorder Examination Questionnaire, which asked participants how often they had engaged in restraint. It was this realisation that prompted individual analysis of the four subscales. The results supported this hypothesis, as the restraint score increased dramatically, as would be expected when doing a daily calorie restriction diet, yet other scores either decreased or remained stable.

The finding that binge-eating and food cravings didn’t increase, and actually both reduced following starting the CR diets has the potential to provide helpful information for individuals who have a BMI within the overweight and obese ranges and want to lose weight through CR. However, given the learnings from previous literature and theories of eating disorders, some individuals who engage in CR in an attempt to lose weight do go on to develop eating disorder symptoms, including binge-eating. I had hypothesised that scoring highly in the risk factors for eating disorders would increase the likelihood of experiencing adverse psychological outcomes in association with commencing the diet. I am therefore surprised that none of the measured risk factors were associated with global eating disorder symptoms or binge-eating symptoms. It would therefore be interesting to understand more about the individuals who participated in the current research study, particularly with regards to the factors that were protecting them from the potentially adverse consequences sometimes seen in association with commencing a CR diet.

5.0 Personal reflections

The current research project has been an emotionally and intellectually challenging experience, particularly with regards to recruitment and data analysis.
However, it has presented an opportunity to learn about the role of a clinical psychologist as a scientist practitioner; developing and carrying out a novel and clinically relevant research project alongside various other demands such as working clinically. Importantly and similar to my clinical work, I have learnt the importance of not being wedded to my research hypotheses. Whilst personal and clinical experience led to initial assumptions that the CR regimes would be associated with adverse psychological outcomes, staying curious helped me to think of possible explanations for my research findings and how they fit in the context of previous findings.
6.0 References


Appendices

Appendix A: Participants Recruitment Advertisements
Appendix B: Food Diary
Appendix C: Participant Information Sheet, Consent Form and Instructions
Appendix D: Ethical Approval for Study
Appendix E: Details of Collaboration in Joint Project
Appendix A

Participants Recruitment Advertisements

ARE YOU THINKING OF STARTING THE 5.2 ‘FAST’ DIET OR A LOW-CALORIE DIET?

We are exploring the psychological effects of the 5.2 diet and low calorie diets (15-25% daily calorie reduction) in healthy adults. We will compare how people answer certain questions before and after starting their diet and how they perform on online tasks. Participation will involve completing some online questionnaires and short tasks. You can participate from anywhere as it all takes place online.

For more information or to sign up, please email us at: ucl.fasting.research@gmail.com

All data will be collected and stored in accordance with the Data Protection Act 1998.
This study has been approved by the UCL Research Ethics Committee: 1995/001
ARE YOU THINKING OF, OR HAVE YOU ALREADY STARTED, A DIET OR HEALTHY EATING PLAN?

WHAT? We are exploring the psychological effects of engaging in eating plans aimed at weight loss.

HOW? It takes place over a six week period and involves weekly questionnaires and two short online tasks. It’s all online so it’s quick & easy to participate.

WHY? Contribute to instrumental psychological research. Understand more about the impact of dieting and healthy eating plans on psychological processes such as mood and cognition.

To find out more, email: ucl.fasting.research@gmail.com

All data will be collected and stored in accordance with the Data Protection Act 1998
This study has been approved by the UCL Research Ethics Committee: 12965/001
Appendix B

Food Diary

<table>
<thead>
<tr>
<th>Participant number:</th>
<th>Time/Date</th>
<th>Situation (where, when, with etc.)</th>
<th>Initial hunger level (0-10)</th>
<th>Mood</th>
<th>Any other comments</th>
<th>Sense of loss of control</th>
<th>Amount</th>
<th>Food drink</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7pm 22nd</td>
<td>Dinner in a restaurant with friends</td>
<td>6</td>
<td>Happy (70%)</td>
<td>No</td>
<td>No</td>
<td>1 10&quot; pizza</td>
<td>Italian white pizza with ham, mushrooms, cheese and tomato. White wine.</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td></td>
<td></td>
<td>Tired (40%)</td>
<td>No</td>
<td>No</td>
<td>1 large glass</td>
<td>2 Ryvita, 2 tbsp of cheese</td>
</tr>
<tr>
<td></td>
<td>8.30am 23rd</td>
<td>Breakfast at my desk in office, alone checking emails.</td>
<td>4</td>
<td>Bored (50%)</td>
<td>No</td>
<td>No</td>
<td>1 mug tea, splash of milk</td>
<td>Ryvita with cottage cheese. Tea (breakfast tea) with milk</td>
</tr>
</tbody>
</table>
Appendix C
Participant Information Sheet

For individuals who are considering, or who have already begun the 5:2 or a calorie restricted diet.

UCL Research Ethics Committee Approval ID Number: 12695/001

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

Title of Study: The impact of Intermittent Fasting on thinking, mood and eating behaviours

Department: Research Department of Clinical Educational and Health Psychology

Name and Contact Details of the Researcher(s): John O’Leary (john.o’leary.16@ucl.ac.uk)
Freya Donaldson (f.donaldson.16@ucl.ac.uk)

Name and Contact Details of the Principal Researcher: Dr Lucy Serpell (l.serpell@ucl.ac.uk)

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

1. What is the project’s purpose?
The aims of this study are (1) to find out about the impact of starting or remaining on the 5:2 diet on mood, eating behaviour and ability to do certain mental tasks and (2) to explore whether there are any differences between the impact of this diet compared to a continuous calorie restriction diet (low-calorie diet). The project will run for 1 year.

2. Why have I been chosen?
You have been chosen to take part in this study because you are a healthy adult (over 18 yrs) who has started, or is planning to start the 5:2 or a low calorie diet (15-25% calorie restriction per day) diet. The study also requires that participants are able to speak and read English, are computer literate and have normal or corrected to normal visual acuity (in order to complete online questionnaires and online tasks). If dieting might put your health at risk, for example if you have diabetes or you are pregnant, you will unable to take part. If you are diagnosed with a moderate-severe intellectual disability, have a past or current eating disorder or any other mental health diagnosis, you are also unable to take part in the study.

3. Do I have to take part?
It is up to you to decide whether to take part. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form). You can withdraw at any time without giving a reason and without it affecting any benefits that you are entitled to. If you decide to withdraw you will be asked what you wish to happen to the information you have provided up that point.

4. What will happen to me if I take part?
If you decide to participate and haven’t already started the diet:
We will ask you to complete a food diary for one week and fill out a series of questionnaires online which will ask about your mood, eating behaviours, self-esteem and thinking about food, shape and weight (around 20 minutes). You will then begin dieting. We will then ask you to complete some of the same questionnaires again on a weekly basis (10-15 minutes). As you approach 28 days of being on the diet, you will be asked to complete the food diary again and the questionnaires for
the last time (5 times in total). After 28 days of dieting you will move to the second part of the study and complete some online tasks (lasting about 20 minutes) on two different days.

If you have already begun your diet for a period of 4 weeks or more:
We will only ask you to complete some online tasks (lasting about 20 minutes) on two different days.

We will use the data to compare how people answer certain questions before and after starting the diet, and how they do on some computer tasks on fasting and non-fasting days.

5. What are the possible disadvantages and risks of taking part?
Some questions will ask you about body image, eating behaviour, mood and self-esteem so it is possible that you may find them upsetting. It is also possible that the process of following the diet may lead to changes in mood or you may experience symptoms that are more common in eating disorders. If you feel distressed or have changes in your eating behaviour that worry you, please contact us using the contact details at the top of this information sheet. We will then discuss your difficulties and your options for further support.

6. What are the possible benefits of taking part?
Whilst there are no immediate benefits for those people participating in the project, some participants may find it useful to track their mood, behaviours and other psychological variables when they start following their chosen diet, and may find the tasks interesting to complete. In addition, participants may find it interesting to learn of the findings of this study.

Participants will also be entered into a prize draw to win Amazon vouchers. Student participants recruited through the Sona system also receive course credits for participation.

7. What if something goes wrong?
If you feel that you have been treated unfairly or incorrectly by our research team, then you can make a formal complaint by using the contact details below.

Dr Lucy Serpell
Research Department of Clinical, Educational and Health Psychology
University College London
Gower Street
London WC1E 6BT. Tel: +44(0)207679 1897
Should you feel your complaint has not been handled to your satisfaction then you can contact the Chair of the UCL Research Ethics Committee – ethics@ucl.ac.uk

If you feel that you are becoming distressed during or straight after your participation in the research study, then please do not hesitate to contact the researchers directly, using the details above. If you feel that taking part in this study has contributed to changes in your diet or eating habits, which are causing you to feel distressed, then please contact the researchers, your General Practitioner or visit https://www.bsequad.org.uk who can provide support over the phone.

8. Will my taking part in this project be kept confidential?
All information provided (along with your personal details) will be kept confidential, anonymized and stored on a secure database. Your personally identifiable details will not be linked to your individual
responses. No information about you will be disclosed to a third party and you will not be able to be identified in any ensuing reports or publications.

9. Limits to confidentiality

Please note that assurances on confidentiality will be strictly adhered to unless evidence of potential harm to yourself during the research process is uncovered. In such cases the University may be obliged to contact relevant statutory bodies/agencies.

10. What will happen to the results of the research project?

The results of the study will be written up into two theses for submission for the Doctorate in Clinical Psychology and submitted to the Department of Clinical, Health and Educational Psychology in June 2019. Interested participants will be provided with a summary sheet of the overall study’s results.

The study will aim to be published in peer-reviewed journals following the completion of the Doctorate.

11. Data Protection Privacy Notice

Notice:
The data controller for this project will be University College London (UCL). The UCL Data Protection Office provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk. UCL’s Data Protection Officer is Lee Shailer and he can also be contacted at data-protection@ucl.ac.uk.

Your personal data will be processed for the purposes outlined in this notice. The legal basis that would be used to process your personal data will be the provision of your consent. You can provide your consent for the use of your personal data in this project by completing the consent form that has been provided to you.

*Your personal data will be processed so long as it is required for the research project.* We will anonymise the personal data you provide, and will endeavour to minimise the processing of personal data wherever possible. If you are concerned about how your personal data is being processed, please contact UCL in the first instance at data-protection@ucl.ac.uk. If you remain unsatisfied, you may wish to contact the Information Commissioner’s Office (ICO). Contact details, and details of data subject rights, are available on the ICO website at: https://ico.org.uk/for-organisations/data-protection-reform/overview-of-the-gdpr/individuals-rights/

Given the nature of this information we will be storing your personal details in a secure, password-protected database and assigning each participant a unique ID code so that your personal details remain anonymous and separate from the other variables collected during the research. Only the two main researchers (John and Freya) will have access to this database. Your personal details will remain anonymous and confidential on the study information sheet provided to all interested individuals, and you will be provided with an opportunity to ask the researchers any questions you have about anonymity prior to consenting to participate.

12. Who is organising and funding the research?

This research is being undertaken in collaboration with University College London, Gower Street London WC1E 6BT
16. Contact for further information
For further information relating to this study, please contact;
Dr Lucy Serpell
University College London
Gower Street
London WC1E 6BT

Tel: +447679 200 Ext.41256

You will be provided with a copy of this information sheet, and a signed consent form for your reference.

Thank you for reading this information sheet and for considering taking part in this research study.
Informed consent form for adult participants in research studies
Please complete this form after you have read the information sheet and/ or listened to an explanation about the research.

**Project Title:** The impact of fasting on thinking, mood and eating behaviours

**Department:** Department of Clinical, Educational and Health Psychology

**Name and contact details of the researchers:** Freya Donaldson and John O’Leary, ucl.fasting.research@gmail.com

**Name and Contact Details of the Principal Researcher:** Lucy Serpell, l.serpell@ucl.ac.uk

**Name and Contact Details of the UCL Data Protection Officer:** Lee Shailer, l.shailer@ucl.ac.uk

This study has been approved by the UCL Research Ethics Committee: Project ID number: 12695/001

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

I confirm that I understand that by electronically ticking/initiating each box below I am consenting to this element of the study. I understand that it will be assumed that unticked/initiated boxes means that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

<table>
<thead>
<tr>
<th></th>
<th>Tick or initial</th>
</tr>
</thead>
</table>
| 1 | I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction. I would like to take part in (please tick one or more of the following):
|   | - The online cognitive testing
|   | - The online questionnaires measuring emotional wellbeing and eating behaviours. |
| 2 | I consent to the processing of my personal information (demographics, food diary, questionnaires measuring emotional well-being and eating behaviours, online cognitive test results) for the purposes explained to me. I understand that such information will be handled in accordance with all applicable data protection legislation. |
| 3 | Use of the information for this project only:
|   | I understand that all personal information will remain confidential.
|   | I understand that my data gathered in this study will be stored anonymously and securely. It will not be possible to identify me in any publications.
|   | I understand that I will be given a unique ID code, which will be used when completing questionnaires and the online cognitive test. Personal details will be saved on a secure, password-protected database, stored on the UCL.
<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>network. Only researchers will have access to this database. All efforts will be made to ensure I cannot be identified.</td>
</tr>
<tr>
<td>4</td>
<td>I understand that my anonymous information may be subject to review by responsible individuals from the University for monitoring and audit purposes.</td>
</tr>
<tr>
<td>5</td>
<td>I understand the potential risks of participating and the support that will be available to me (to contact the researchers, advice to contact GP or eating disorder charity contact details) should I become distressed during the course of the research.</td>
</tr>
<tr>
<td>6</td>
<td>I understand that no promise or guarantee of benefits have been made to encourage me to participate. However, I understand that I will be entered in to a prize draw with the possibility of winning Amazon vouchers.</td>
</tr>
<tr>
<td>7</td>
<td>I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researchers undertaking this study.</td>
</tr>
<tr>
<td>8</td>
<td>I understand that I will not benefit financially from this study or from any possible outcome it may result in in the future.</td>
</tr>
<tr>
<td>9</td>
<td>I agree that my anonymized research data may be used by others for future research. No one will be able to identify you when this data is shared.</td>
</tr>
</tbody>
</table>
| 10 | I understand that the information I have submitted will be published as a report and I wish to receive a copy of it.  
- Yes  
- No |
| 11 | I hereby confirm that I understand the inclusion criteria as detailed in the Information Sheet and explained to me by the researcher. |
| 12 | I hereby confirm that:  
(a) I understand the exclusion criteria as detailed in the Information Sheet and explained to me by the researcher; and  
(b) I do not fall under the exclusion criteria. |
| 13 | I agree that my GP may be contacted if any unexpected results are found in relation to my health. |
| 14 | I have informed the researcher of any other research in which I am currently involved or have been involved in during the past 12 months. |
| 15 | I am aware of who I should contact if I wish to lodge a complaint. |
| 16 | Use of information for this project and beyond  
I would be happy for the anonymous data I provide to be archived at UCL. Personal identifiable information (name linked to ID code) will be kept for 1 year. Anonymised research data will be kept for 10 years. |
Dear XXX,

Thank you very much for agreeing to give your time to take part in our intermittent fasting (IF) study. Remember that you can decide that you no longer wish to take part at any point in the future without having to give a reason.

Attached to this email is a document which has an outline of the whole study so you have a clear idea of what you will need to do and when. You will receive an email each week reminding you and directing you to the next stage. All of the study can be completed online, via the links that we email to you.

We agreed that you would begin the food diary **Monday 18th June**, complete the first set of questionnaires by **Sunday 24th June** and then start following the intermittent fasting 5:2 diet the day after that on **Monday 25th June**. You are free to follow the diet in the way that you choose, and to decide which two days of the week you wish to 'fast' (meaning limiting your intake to 500cals for women and 650 cals for men). We will send you a link to some questionnaires each week of the diet and we ask that they are completed within three days of receiving them (on a non-fasting day).

Once you have reached the second part of the study we would ask you to complete the first set of cognitive tasks on a non-fasting day, and the second set on a fasting day in the evening (6-10pm) at the same time each time.

You have been assigned the participant number XXXX. Please use this number whenever you complete part of the study, and do not use your name. This will help us to link your data together while ensuring that it remains anonymous and secure. When password protecting documents, the password is: UCLif2

We have attached a blank food diary. Could you please fill this in in the week prior to starting the diet and email it back to the researchers in a password protected document (UCLif2) Please write your participant number but not your name on this diary.

If you have any questions or concerns, or feel that you need more information to help you complete the study, please do not hesitate to get in contact with us.

Thank you again for your help,

Freya and John
Trainee Clinical Psychologists
UCL DClinPsy Programme
1-19 Torrington Place
London
WC1E 7HB
Participants in the 5.2 diet group: participation processes

The week before the diet
Fill in the food diary: record everything you eat and drink for 7 days.
Complete the first set of questionnaires online. You will be sent the link to do this via email. This will take around 20 minutes.

The day before the diet
Make sure the questionnaires are completed and you have sent the food diary back to the researchers.

Day 1 of the diet
Start following the 5.2 IF diet in the way that you choose. Two days per week are fasting days - limit intake to 500cals for women and 650cals for men. You can choose which days to fast and how you do this. The other 5 days eat whatever you like.

Day 5-7 of the diet
You will be sent a link to complete the second set of questionnaires online via email. Please complete these on a non-fasting day. These will take around 10-15 minutes.

Day 12-14 of the diet
You will be sent a link to complete the third set of questionnaires online via email. Please complete these on a non-fasting day. These will take around 10-15 minutes.

Day 19-21 of the diet
You will be sent a link to complete the fourth set of questionnaires online via email. Please complete these on a non-fasting day. These will take around 10-15 minutes. You will also be sent another blank food diary to complete in your fourth week of the diet. You should record everything you eat and drink over the next week, while continuing to follow the diet as you already have been.

Day 26-28 of the diet
You will be sent a link to complete the final set of questionnaires online via email. Please complete these on a non-fasting day. These will take around 10-15 minutes.

Part B
Once you have been following the diet for one month you will be sent an email asking you to start the next part of the study. This will contain instructions and a link where you can complete a number of online tasks. You will complete these tasks twice, once on a fast day and once on a non-fast day. Each testing session will take around 20 minutes.

After completing the study
We will contact you by email or phone to answer any questions you may have. You are free to continue or stop following the diet as you wish. You will have been entered in to the Amazon prize draw which will be drawn when enough data has been collected. We will contact you if you have won a prize. Once we have analysed the data we will send you a summary of our findings. We will also write up our study for publication so that other people can learn from our findings.
Initial Instructions for Low Calorie Group

Dear XXXX,

Thank you very much for agreeing to give your time to take part in our intermittent fasting (IF) study. Remember that you can decide that you no longer wish to take part at any point in the future without having to give a reason.

Attached to this email is a document which has an outline of the whole study so you have a clear idea of what you will need to do and when. You will receive emails over the next 5 weeks reminding you and directing you to the next stage. All of the study can be completed online, via the links that we send you.

We agreed that you would begin the food diary tomorrow, XX, complete the first set of questionnaires by XX and then start following the low calorie diet the day after that on XX. You are free to follow the diet in the way that you choose, aiming to restrict your calorie intake by between 15-25%. We will send you a link to some questionnaires each week of the diet and we ask that they are completed within three days of receiving them.

Once you have reached the second part of the study we would ask you to complete the first set of cognitive tasks in the evening (6-10pm) and then again on another day at the same time.

You have been assigned the participant number XX. Please use this number whenever you complete part of the study, and do not use your name. This will help us to link your data together while ensuring that it remains anonymous and secure. When password protecting documents, the password is: UCLif2

We have attached a blank food diary. Could you please fill this in in the week prior to starting the diet and email it back to the researchers in a password protected document (UCLif2) Please write your participant number but not your name on this diary.

If you have any questions or concerns, or feel that you need more information to help you complete the study, please do not hesitate to get in contact with us.

Thank you again for your help,

Freya and John
Trainee Clinical Psychologists
UCL DClinPsy Programme
1-19 Torrington Place
London
WC1E 7HB
Participants in the low-calorie diet group: participation processes

**The week before the diet**
Fill in the food diary: record everything you eat and drink for 7 days.
Complete the first set of questionnaires online. You will be sent the link to do this via email. This will take around 20 minutes.

**The day before the diet**
Make sure the questionnaires are completed and you have sent the food diary back to the researchers.

**Day 1 of the diet**
Start following the low calorie diet in the way that you choose. The low calorie diet means restricting your calorie intake by 15-25% per day. This is 1500-1700 calories for women and between 1875-2125 for men per day.

**Day 5-7 of the diet**
You will be sent a link to complete the second set of questionnaires online via email. These will take around 10-15 minutes.

**Day 12-14 of the diet**
You will be sent a link to complete the third set of questionnaires online via email. These will take around 10-15 minutes.

**Day 19-21 of the diet**
You will be sent a link to complete the fourth set of questionnaires online via email. These will take around 10-15 minutes. You will also be sent another blank food diary to complete in your fourth week of the diet. You should record everything you eat and drink over the next week, while continuing to follow the diet as you already have been.

**Day 26-28 of the diet**
You will be sent a link to complete the final set of questionnaires online via email. These will take around 10-15 minutes.

**Part B**
Once you have been following the diet for one month you will be sent an email asking you to start the next part of the study. This will contain instructions and a link where you can complete a number of online tasks. You will complete these tasks twice, on two different days. Each testing session will take around 20 minutes.

**After completing the study**
We will contact you by email or phone to answer any questions you may have. You are free to continue or stop following the diet as you wish. You will have been entered in to the Amazon prize draw which will be drawn when enough data has been collected. We will contact you if you have won a prize. Once we have analysed the data we will send you a summary of our findings. We will also write up our study for publication so that other people can learn from our findings.
Baseline Questionnaire Testing Session Instructions

Dear XXX,

Please complete the first set of questionnaires as part of our intermittent fasting study before the date previously agreed. You can complete this by clicking on the link below. This should take about 20 minutes.

https://uclpsych.eu.qualtrics.com/jfe/form/SV_bparBxj6hjxwrdz

Please make sure that you enter your participant number, which is XXX. You should not enter your name. I have also attached a questionnaire called the Shape and Weight Based Self-Esteem Scale (SAWBS), which is in a format that is difficult to complete online. Could you complete this, either electronically using Microsoft Word or by printing it, completing it and scanning it, and then email it at the same time as the food diary. Both of these documents should have your participant number written on them and should be password protected using the password diet (UCLif2). If you have difficulties emailing these documents you can freepost them to us (see address below).

Reminder:

Once you have completed the questionnaire and your food diary, you are free to start your diet as you choose.

If you are following the 5:2 diet, it involves having two fasting days per week, where you eat no more than 500cals for women and 650cals for men, and then eating what you like for the rest of the week. You can choose which days you want to fast and how you want to plan your meals on those days.

If you are following the low-calorie diet, it involves restricting your calorie intake by 15-25% per day. This means you will eat between 1500-1700 calories for women and between 1875-2125 for men per day.

We will be in touch again in one week to let you know about the next part of the study. In the meantime, if you have any questions, please do get in touch.

Thank you for your time,

Freya and John

Email:

Post: FREEPOST University College London, London WC1E 6BT Department of Clinical, Educational and Health Psychology (Attention: Freya Donaldson, DClinPsy trainee) (Please let me know if you have posted so I know to check the FREEPOST)
Weekly Questionnaire Testing Session Instructions

Dear XXX,

It is now time for you to complete the *second* set of questionnaires as part of our intermittent fasting study. You can complete this by clicking on the link below. This should take about 10-15 minutes.

https://uclpsych.eu.qualtrics.com/jfe/form/SV_3luTNT29LHYHzIF

Please do take the time to complete these, so that we can use your data. If you are following the 5:2 diet, it is important that you complete these questionnaires on a *Non-Fasting Day*.

Please make sure that you enter your participant number, which is XXX. You should not enter your name.

Reminder:

If you are following the 5:2 diet, this involves having two fasting days per week, where you eat no more than 500cals for women and 650cals for men, and then eating what you like for the rest of the week. You can choose which days you want to fast and how you want to plan your meals on those days.

If you are following the low-calorie diet, this involves restricting your calorie intake by 15-25% per day. This means you will eat between 1500-1700 calories for women and between 1875-2125 for men per day.

We will be in touch again in one week to let you know about the next part of the study. In the meantime if you have any questions, please do get in touch.

Thank you for your time, Freya and John

Final Questionnaire Testing Session Instructions

Dear XXX

It is now time for you to complete the final set of questionnaires as part of our intermittent fasting study. You can complete this by clicking on the link below. This should take about 10-15 minutes.

https://uclpsych.eu.qualtrics.com/jfe/form/SV_0w7gaCsv9brfDil

Please do take the time to complete these, so that we can use your data. If you are following the 5:2 diet, it is important that you complete these questionnaires on a *Non-Fasting Day*.
Please make sure that you enter your participant number, which is XXX. You should not enter your name. At the end of completing the questionnaires, you should email or post me your final food diary with the information about what you have eaten and drunk in the last week. This document should have your participant number written on it and should be password protected using the password that we have agreed (UCLif2).

Once you have completed these questionnaires, you have finished the first part of the study. THANK YOU! If you consented to the second part of this study, you will shortly be sent a link to complete some online tasks (20 minutes). You will be asked to complete these tasks on two separate days.

Thank you again for your time and support,

Freya and John

UCL DClinPsy Programme
Appendix D

Ethical Approval for Study

5th March 2018

Dr Lucy Serpell
Department of Clinical, Educational and Health Psychology
UCL

Dear Dr Serpell

Notification of Ethics Approval with Provisos
Project ID/Title: 12695/001: Investigating the impact of intermittent fasting diets on cognition, behaviour and emotional wellbeing

Further to your satisfactory responses to my comments, I am pleased to confirm in my capacity as Joint Chair of the UCL Research Ethics Committee (REC) that I have ethically approved the data collection element of your study until 1st June 2019.

Ethical approval is subject to the following conditions.

Notification of Amendments to the Research
You must seek Chair’s approval for proposed amendments (to include extensions to the duration of the project) to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing an ‘Amendment Approval Request Form’ http://ethics.grad.ucl.ac.uk/responsibilities.php

Adverse Event Reporting – Serious and Non-Serious
It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator (ethics@ucl.ac.uk) immediately the incident occurs. Where the adverse incident is unexpected and serious, the Joint Chairs will decide whether the study should be terminated pending the opinion of an independent expert. For non-serious adverse events the Joint Chairs of the Ethics Committee should again be notified via the Ethics Committee Administrator within ten days of the incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Joint Chairs will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Final Report
At the end of the data collection element of your research we ask that you submit a very brief report (1-2 paragraphs will suffice) which includes in particular issues relating to the ethical implications of the research i.e. issues obtaining consent, participants withdrawing from the research, confidentiality, protection of participants from physical and mental harm etc.
In addition, please:

- ensure that you follow all relevant guidance as laid out in UCL’s Code of Conduct for Research: http://www.ucl.ac.uk/hrs/governance-and-committees/resgov/code-of-conduct-research

- note that you are required to adhere to all research data/records management and storage procedures agreed as part of your application. This will be expected even after completion of the study.

With best wishes for the research.

Yours sincerely

Dr Lynn Ang
Joint Chair, UCL Research Ethics Committee

Cc: John O’Leary & Freya Donaldson
Appendix E
Details of Collaboration in Joint Project

The empirical research outlined in Part Two of the thesis was undertaken as part of a joint research project with John O’Leary, a fellow trainee clinical psychologist at UCL. Although we had intended on recruiting the same group of participants, this proved difficult as John required participants to have been on the diet for at least four weeks before starting his study, whereas I required participants to have not yet started their chosen diet. It was hoped that participants recruited would complete my part of the study before completing John’s, however, this rarely happened. As a result most recruitment was done independently. The details of John’s part of the project are outlined in his thesis submission: O’Leary, J. (2019). The impact of the 5:2 intermittent fasting diet on cognition in healthy adults. Clinical Psychology Doctorate Thesis.

Aspects of research undertaken independently:

- Review of literature
- Research proposal
- Study design
- Majority of participant recruitment
- Data collection and processing
- Data analysis
- Write up of empirical paper

Aspects of research undertaken jointly:

- Agreeing overall study protocol
- Research governance tasks (application for ethical approval funding, risk assessment, data protection)
- Initial recruitment of participants