

Food Cravings in People Engaged in Weight Management

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The candidate confirms that the work submitted is his/her own and that appropriate credit has been given where reference has been made to the work of others

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ABSTRACT

The relationship between dieting and food cravings has been studied extensively; however, due to varied methodology, questionnaire measures and construct definitions, the evidence is conflicting. The present study was conducted in order to investigate the relationship between cravings, dieting and weight loss using a craving specific measure and gathering data at two different time points during active weight management.

A large national sample of individuals (N=2932) enrolled in a commercial weight loss organisation completed two questionnaires approximately seven weeks apart.

Information was collected on craving experiences, mood, restraint and weight change.

Cross-sectional analysis found those 'dieting to lose weight' reported significantly fewer, less intense and more easily controlled food cravings than those 'watching their weight'. In longitudinal analyses, there was a significant reduction in cravings that could not be accounted for by change in mood or dietary restraint. Frequency of 'eating in response to food cravings' at Time 1 explained 7.1% of the variance in overall weight change, such that those more likely to eat in response to food cravings lost less weight over the period of observation. A significant positive relationship was observed between weight loss and participants' sense of control over their food cravings.

Clinical implications draw attention to the contribution of momentary self-regulatory inhibition when explaining the variance in weight loss, and the reciprocal relationship between perceived control of cravings and weight regulation. The potential benefit of incorporating psychological strategies into weight-loss programmes to help support individuals struggling to cope with food cravings is discussed.

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ABBREVIATIONS

BMI	Body Mass Index
BOS	Bristol Online Survey
COEQ	Control of Eating Questionnaire
COR-I	Contrave Obesity Research I
DASS	Depression, Anxiety & Stress Scale
FCQ-T	Food Craving Questionnaire- Trait version
GP	General Practitioner
IMD	Indices of Multiple Deprivation
LCA	Latent Class Analysis
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
PSDS	Perceived Success of Dieting Scale
SE	Standard Error
SW	Slimming World
TFEQ	Three Factor Eating Questionnaire

INTRODUCTION

With the associated risks and financial implications of treating obesity-related health difficulties, the government are keen to promote services which aim to encourage active lifestyles and healthy diets. Most individuals seeking to reduce their weight will engage in energy (calorie) reduced diets; however, many individuals find it difficult to sustain dietary changes during a period of active weight loss. A commonly reported explanation for dietary ‘lapses’ is one of experiencing a strong and intense desire - a *craving* - to eat a particular food. Once acted upon, the person perceives that they have ‘failed’ the diet; the associated shame and guilt of this experience leading them to revert to their previous dietary habits. Spanning over five decades, researchers have been keen to understand the relationship between dieting, weight loss and cravings. However, there is at present contradictory evidence as to whether food cravings increase or decrease in people who are dieting for weight loss. The present study aims to build on previous research to investigate food craving experiences in people engaged in active weight management. The following review utilised a comprehensive literature search to retrieve a contemporaneous overview of research into food cravings and weight loss (full search strategy provided in Appendix 1). Explanatory theories of craving are outlined and gaps in the evidence base identified.

LITERATURE REVIEW

3.1 Obesity

3.1.1 Social, Economic, Physical & Psychological Impact of Obesity

Obesity is an increasingly pressing problem in the UK. In 2010, 26% of adults were classified as being 'obese', with approximately 2.6% meeting criteria for 'morbidly obese' status ($BMI > 40 \text{ kg/m}^2$) (National Obesity Observatory, 2012). Due to the associated increases in morbidity and mortality, the numbers of adults requiring treatment for obesity related health issues is putting pressure on the NHS. In addition to the links between obesity and a number of chronic conditions such as diabetes, hypertension, liver and cardiovascular disease, obesity has also been shown to be related to reduced quality of life, increased risk of stroke, disability and premature death. A review of prospective observational studies suggested a strong association between increases in body mass (kg/m^2) and increased incidence of a number of different forms of cancer (Renehan, Tyson, Egger, et al, 2008).

The associated cost to the NHS of treating obesity related health issues has been estimated at £4.2 billion in 2007 and the wider burden to the economy through indirect costs (e.g. unemployment/ loss of productivity) have been estimated at up to £15.8 billion (Morgan & Dent, 2010). In a systematic review of the economic burden of obesity, Withrow and Alter (2011) suggest that an obese individual will accrue medical costs 30% higher than those within normal range weight. In the past forty years, the proportion of people being classified as overweight and obese has risen dramatically; if such trends were to continue at the same rate it is estimated that by

2020 seven out of ten people would be above 'normal range' BMI. As such, there is a growing impetus to further explore factors associated with changes in body mass trajectories in order to establish effective intervention strategies.

In addition to the medical complications of obesity, there is mounting evidence to suggest that such individuals present with a greater incidence of psychological difficulties. Not only are these difficulties found to be related to self-esteem and body distortion, but studies have found a positive association between BMI and depression (Dixon, Dixon & O'Brien, 2003). Further, the psychopathology observed in overweight/obese individuals is in many cases a consequence of social, familial and occupational discrimination; as one paper comments, obesity could be considered 'the last bastion of prejudice' (Flanagan, 1996).

3.1.2 Strategies to Reduce Obesity

Given the numerous associated health risks and cost to the NHS, the Government is keen to promote services which aim to encourage active lifestyles and a healthy diet. The National Institute for Health and Care Excellence (NICE; 2006) suggests that NHS authorities should provide advice and guidance to adults concerned about their weight and to encourage physical activity. Suggestions are made to prioritise the prevention and management of obesity, ensuring that appropriate resources are available to meet these demands. Clinical care pathways take in to consideration the multifaceted nature of obesity, involving thorough assessment of the individual's lifestyle, motivation to change and psychological problems, referral to specialist services if necessary and continued monitoring. In support of the clinical

management of overweight and obese patients, there are drives for local authorities to work with local businesses in increasing the availability of schemes promoting active life choices (e.g. cycle-to-work schemes), and for on-site catering to promote healthy food options.

In addition to national campaigns to increase awareness on a cultural level, the NHS has begun to make referrals directly to commercial weight loss organisations – so-called Slimming on Referral. Such referrals are usually provided with a programme of twelve sessions free of charge and can be accessed directly from the individual's GP. A review of such an initiative found that group members lost on average 5.4kg across a twelve week period and sustained the weight loss up to 24 weeks later (Pallister & Lavin 2010). Strategies utilised by commercial weight-loss organisations involve the use of structured group support and are informed by psychological principles in order to promote active behaviour change. Comparison studies of weight loss in people enrolled in commercial weight loss groups against standard care have found those enrolled in commercial groups to lose almost twice as much weight across a 12 month period (Jebb, Ahern, Olson, et al., 2011).

3.1.3 Effectiveness & Efficacy of Weight-Loss Intervention Strategies

Despite some positive findings for the effectiveness of successful weight loss during participation in community weight loss clubs - initial weight loss was reported to be 9.9 kg (diet alone) and 13.0kg (diet with exercise) in a review by Curioni and colleagues (2005) - enrolment into such an initiative does not necessarily lead to weight loss for all individuals. Further, for those who do lose weight in the short

term, there is pessimism that any initial success may not always result in long-term weight-maintenance. In Curioni's paper, they found that up to 50% of individuals regained their weight back to baseline after twelve months. These findings, in addition to a number of studies documenting an association between frequent dieting and weight gain (Teixeira, Going, Houtkooper, et al, 2004), have contributed to the popularly held assumption that dieting paradoxically increases the likelihood of future weight gain and bingeing (Polivy & Herman, 1985). However, later reviews have revealed that whilst chronic dieters do tend to gain more weight than non-dieters, the increased risk equates to approximately 0.5kg per year (Hill, 2004). In trying to ascertain the effectiveness of weight loss strategies, researcher attempts are fundamentally thwarted by the heterogeneity of pooled interventions and the tendency for studies to report the overall mean change in weight rather than number of individuals attaining their expected weight loss.

Systematic evaluations of the efficacy of such initiatives are limited (Lemmens, Oenema, Klepp, et al., 2008) and retention rates of individuals enrolled in NHS led programmes are found to be poor. In a randomised controlled trial of four community based samples of weight loss interventions, Truby and colleagues (2006) found that 64% of the total number had withdrawn by the eighth week of the diet. At this point, only 8% had lost greater than 5% of their body weight compared to 25% of those remaining in the trial. A second study evaluating a comprehensive service intervention found that approximately 62% of those opting in to the programme did not complete the 16 week programme (Morrison, Boyle, Morrison, et al., 2012).

Research thus far has had little success in determining personal or demographic factors to ‘predict’ successful weight loss or programme completion (Stubbs, Brogelli, Pallister, et al., 2012; Teixeira, Goings, Hootkooper, et al., 2004), however there have been associations found between older age and programme completion (Morrison, Boyle, Morrison, et al., 2012). One frequently reported reason for not adhering to weight loss programmes is the presence of frequent, strong, irresistible desires to eat a ‘forbidden’ food; in other words, a food *craving*. In order to increase retention in programmes of weight loss intervention, it is therefore important to understand the link between dieting, food craving and weight loss.

3.2 *Dietary Intake and Food Cravings*

In the 1940’s, a group of healthy male volunteers took part in an experiment to examine the effects of starvation on the human body (Keys, Brozek, Henschel, et al., 1950). In addition to the physiological changes and impact on basic bodily functions, Keys and colleagues were keen to understand the psychological impact of maintaining such a limited diet. The results from this seminal study have informed a body of research investigating the cognitive effects of food deprivation and its relationship with eating disordered behaviour. What was found was that many of Keys’ participants became obsessed with food; collecting recipes, reading cookbooks and demonstrating an increased awareness of what other people were eating over and above other environmental factors (Keys et al, 1950). In this extreme example, participants’ restricted-energy diet led to their being consumed by thoughts or ‘cravings’ for food. The following sections provide theoretical explanations for the experience of cravings during changes in food consumption.

3.2.1 Physiological Theory of Food Cravings

Early explanations for the obsessive thoughts and subsequent bingeing behaviour exhibited by the men in Keys' study suggested that cravings were a physiological response to a depleted caloric or nutritional state. Biological explanations rest on the premise that eating behaviour is regulated by mechanisms which maintain a steady energy balance within the body (homeostasis); cravings, therefore, are proposed as being indicative of the body's need for a certain substance. The physiological account of food cravings is justified by studies that have found people will crave specific food types following selective food restriction. In a study by Coelho and colleagues (2006) participants placed on either a protein or carbohydrate restricted diet craved - and subsequently consumed more of - the restricted food type. Other studies have asserted the role of hormonal factors in the experience of food cravings, with specific reference to women's experience of craving sweet foods during menstruation (see Weingarten & Elston, 1990, for a review). However, in these early studies the measurement of craving was uncertain and conclusions were often circular - the food was eaten because it was craved, it was craved because it was eaten. Additionally, the studies stopped far short of confirming this hypothesis - Weingarten & Elson argued that if women are craving chocolate during menstruation to satisfy a need for magnesium, why do they not report cravings for alternative sources such as nuts, kale and fish? A second argument against the regulatory function of cravings came from Rogers & Smit (2000) who suggested that the body's appetite control system has evolved such that it is more than equipped to manage fluctuations in the availability of food. The authors suggest that it is unlikely that

there would be such an immediate reaction to variations in calorie intake, and therefore be permissive of over- or under-eating.

3.2.2 *Restraint Theory of Food Cravings*

The evidence outlined in the previous section argued for a biological explanation of food cravings arising as a result of nutritional imbalance and restricted food types. Working from this assumption, researchers began to investigate cravings in the context of restricted food intake, with the aim of further understanding factors involved in the development of anorexia and bulimia nervosa. Based on the assumption that attempts to maintain weight through calorific restriction would lead to physiological triggers to address bodily imbalance (cravings), Herman and Mack (1975) observed the eating behaviour of 'restrained' and 'unrestrained' females in response to an attractive food cue. The study found that restrained eaters ate more than those who had not been restricting their intake, a finding that led to the development of 'Restraint Theory'. The authors hypothesized that repeated attempts to control weight through dietary restriction leads to a reduced sensitivity to physiological cues for hunger and satiety, and subsequently to increased food intake when cognitive control is compromised (Polivy & Herman, 1985; Polivy & Herman, 1976). In a development of the theory, antecedents to the changes in eating behaviour were investigated and evidence of an association between food cravings and high dietary restraint began to accumulate (Gendall, Joyce, Sullivan, et al., 1998). Given evidence that restrained eaters tended not to lose weight over time, it was suggested that the increase in food cravings could not be arising from a regulatory mechanism to increase calorific intake. The association between dieting and craving was therefore postulated to arise as a result of *psychological* deprivation

of the desired food, rather than a physiological need (Polivy, Coleman & Herman, 2005; Polivy, 1996). Thus, through attempts to avoid thinking about or eating the tempting 'forbidden' food, the food will become even more attractive and difficult to resist; a psychological 'rebound' effect leading to increased cravings.

Efforts to understand the psychological processes involved in food cravings made comparisons to Ironic Process Theory (Wegner, 1994), in which individuals experience a 'rebound effect' after attempts to cognitively suppress specific thoughts. In relation to dieting behaviour, researchers have suggested that attempts to suppress food-related thoughts may paradoxically increase food-related intrusions (experienced as cravings). In a demonstration of this process, Barnes & Tantleff-Dunn (2010) found that food thought suppression predicted craving, whilst Erskine and colleagues (2010) found that restrained eaters instructed to suppress thoughts about chocolate ate significantly more than those asked to talk about chocolate. Thus, intentionally making certain foods or food types 'forbidden', and actively avoiding thinking about food when dieting may unintentionally increase a drive towards - or a craving for - the 'forbidden' food.

In an effort to marry the physiological and psychological explanations, Rogers and Smit (2000) proposed a biopsychosocial model of food craving. The central factors in the model are the psychological effects of ambivalence to certain food types (e.g. chocolate), normal appetitive control, learned 'cues' for hedonic eating, and the contribution of social and cultural 'norms' relating to food intake. The authors pose several interesting questions in their discussion of what constitutes a food 'craving',

and how to identify the occasions when eating is attributed to a preceding craving. These considerations are explored further in the next section.

3.3 *Dieting and Food Craving*

3.3.1 *Defining and Measuring 'Cravings'*

Although 'craving' is a familiar concept in lay terms and used in day-to-day conversation, a number of differing interpretations have been used throughout the literature and often without providing participants with a clear definition by which to base their responses. The definition is further complicated by its use within other circumstances such as drug and alcohol addiction. In these contexts, the term craving is associated with intense psychological states, dependence, tolerance, and changes in conduct. Such definitions cannot be easily transferred onto food-related behaviour, primarily because eating is a fundamental necessity of life, but also unlike substance abuse, cravings for food are weakly associated with subsequent consumption and because 'food' is not one specific substance (Hill, 2007). At the time of writing, the term 'craving' had been used in research typically as an 'intense urge to eat' or as the person 'going out of their way to satisfy the craving'. However, such definitions are problematic in that not all cravings lead to eating, and there is no consensus as to how strong an urge must be before it could be described as a craving.

In the context of food and eating, the term 'craving' is a hypothetical construct. Weingarten and Elston (1990) discuss the inherent difficulties in investigating psychological concepts which can neither be directly observed nor discretely

measured. Researchers in favour of the physiological understanding of food cravings have utilised physiological measures to measure and quantify cravings. Salivation, heart rate and blood pressure have all been measured and purported to represent an observable indicator of 'craving'. However, the causal relationship between the two events is less than clear and it is argued that salivary secretion is more likely to be due to anticipation for the given food (Polivy et al, 2005) and is no more unique to food than it is to other substances (Weingarten & Elston, 1990). Further, such methods fail to provide any information on the subjective experience of the craving experience. A second observable measure of craving has utilised food consumption; however, this method is logically flawed in the circularity of the argument (see section 3.2.1) and additionally vulnerable to measurement error due to the weak association between craving and subsequent consumption (Weingarten & Elston, 1990).

Likened to 'moreishness' (Rogers & Smit, 2005) and associated with palatability (Pelchat & Shaefer, 2000), *psychological* measures of 'food craving' most commonly define the construct by two components: intensity and specificity. Craving intensity is considered important in order to distinguish it from other food choices whilst specificity allows the craving to be distinct from ordinary hunger (Pelchat, 2002). Self-report measures of food craving tend to focus on how strong the craving experience was and the direction of the craving towards a specific food, taste, or drink. A number of methods have been utilised to ascertain a descriptive measure of food cravings. Whilst some studies have conducted structured interviews (Pelchat, 1997), or used inventories to identify the most commonly craved food types, questionnaires are more frequently used in order to gather information from a

larger and more diverse population group. The Food Craving Inventory was initially developed by White and colleagues (2002) to capture the wider subjective experience of food craving in the context of hunger, affect and reward. The measure has been used across a large number of studies and has been translated into different languages, however at 39 items this measure is lengthy for participants to complete and does not adequately assess the salient features of the craving experience, namely the frequency, intensity and specificity of the food craving. An alternative measure widely used throughout the literature is the Food Craving Questionnaire-Trait (FCQ-T) developed by Cepeda-Benito and colleagues (2000). The questionnaire measures aspects of food-craving such as intention to eat craved foods, anticipation of positive reinforcement from eating the craved food and thoughts and preoccupation with food, in addition to asking participants about their hunger, emotional state and feelings of guilt. However, whilst certainly comprehensive, the measure fails to define to the reader what is meant by the term ‘craving’, and therefore allows for subjective interpretation of what constitutes a ‘food craving’. More recently, the Control of Eating Questionnaire (COEQ) has been developed based on the craving record used by Waters and colleagues (2001) and Massey & Hill (2012). Focusing on the key features of the craving experience, the COEQ uses visual analogue scales to capture information on the frequency, strength, and specificity of food cravings, perceived control over food cravings, overall satiety and current mood. The COEQ can be utilised to record food cravings as a summative reflection across a 24 hour or 7 day period and has been adopted as a central outcome measure in a number of pharmaceutical trials (Wadden, Foreyt, Foster, et al, 2011; Greenaway, Fujioka, Plodkowski, et al., 2010; Wilcox, Oskooilar, Erickson, et al., 2010; Jain, Kaplan, Gadde, et al., 2002).

Due to the diverse interpretations endorsed by researchers, prevalence estimates of cravings in the general population are varied; however, some of the cravings literature suggests that up to 97% of a non-clinical sample will respond 'yes' to the question 'Have you ever experienced food cravings?' (Weingarten & Elston, 1991), thus making the phenomenon a normative, rather than a pathological occurrence. Importantly in relation to the previous discussion, the definition utilised by researchers when measuring food cravings can affect the frequency statistics accrued. In a study by Gendall and colleagues (1997), 101 women completed a structured food craving questionnaire which asked respondents to indicate whether they had ever experienced "an uncontrollable desire to eat a certain food type", "strong urge to eat a specific food" and "a craving for food". The authors found there to be wide variation in the frequency of food 'cravers' depending on the definition used and the recency of food craving experiences. This study highlights the need for participants to be provided with a definition of craving as understood by the researchers, in order to ensure that responses can be reliably compared.

3.3.2 Defining and Measuring 'Dieting'

The term 'dieting' is used both throughout the literature and within common vernacular, to describe a multitude of dietary behaviours and constructs. Whilst 'dieting' is generally understood as a way of managing or controlling food intake, the processes involved in dieting are rarely or poorly described. Lowe (1993) suggests that dieting is not a unitary factor, but involves three factors- i) history of dieting and overeating, ii) current dieting (restricting calorific intake) and iii) weight

suppression ('success' of maintaining weight loss over a period of time). Further, in a recent paper by Witt and colleagues (2013), the inconsistent and contradictory relationship between dieting and craving is attributed to the way in which 'restraint' and 'dieting' had been used interchangeably. The authors describe previous research which found that most individuals scoring high on restraint were not at the time engaged in dietary efforts to lose weight; thus the 'restraint' scale was more a measure of *unsuccessful* chronic dieting. It has been suggested that the inconsistent research findings investigating the relationship between dieting and food craving is hampered by the failure to discriminate between individuals dieting to lose weight and those watching what they eat so that they do not gain/regain weight (Witt, Katterman & Lowe, 2013; Hill, 2007). Research has suggested that whilst some people might consider themselves to be 'on a diet', this might describe efforts to lose weight or efforts to avoid weight gain (Timko, Perone & Crossfield, 2006) and that the two groups are qualitatively different when related constructs are explored (Lowe & Levine, 2005). Lowe (2007) suggests there is a distinct difference between the hunger experienced by individuals dieting to achieve weight loss (homeostatic hunger) and those dieting to avoid weight gain (hedonic hunger), the latter being driven by the psychological consequences of avoiding highly palatable food. Lowe suggests that levels of satiety have relatively little effect on cravings for food that is pleasant and palatable. Thus, researchers interested in dieting and eating behaviour should determine the desired *goal* of the individual engaged in weight management in order to elucidate differences in the craving experiences of the two dieting groups.

Many of the evaluation studies discussed in section 3.1.3 used specific criteria for defining the 'success' rate of individuals enrolled into weight loss intervention

programmes. However, there is at present no unanimous agreement when measuring ‘successful’ weight loss. In a paper discussing the inherent difficulties in evaluating success rates, Wing and Hill (2001) suggest that ‘successful’ dieting should be measured by an intentional loss of at least 10% of initial body weight. The authors derive their criteria from the evidence suggesting that weight loss of 5-10% can lead to considerable improvements in health and risk factors for morbidity (Mertens & van Gaal, 2000; National Institute for Health, 1998). Further, defining ‘successful dieting’ as a return to normal range BMI would fail to acknowledge those individuals who, even after a 10% reduction in body weight, remain at a BMI higher than recommended levels. In addition to the initial weight loss, the authors propose that successful *maintenance* of weight loss should allow for potential weight regain and should be measured across a twelve month period. Using these criteria on data collected by the National Weight Control Registry, the authors suggest that 21% of overweight and obese patients could be classified as ‘successful’ in their weight loss attempts.

3.3.3 *Dieting and Food Cravings: A Review of the Evidence*

Following the work of Polivy and Herman into dietary restraint (1976; 1985), the assumption that dieting behaviour (high restraint) leads to increased food cravings became the dominant discourse. However, the evidence accumulated through investigating this relationship is far from conclusive. Whilst the early studies using the restraint scale suggested a link between restrained eating and craving experiences, the scale has been criticised due to its weak association with food intake and energy balance (Johnson, Pratt & Wardle 2012), with dietary behaviour (Lowe & Levine, 2005), weight change (Lowe, Doshi, Katterman & Feig, 2013), and the

weak association between craving and restraint (Hill 2007; Hill, Weaver & Blundell, 1991; Weingarten & Elston 1991). Further, the evidence base that *has* revealed a relationship between dietary restriction and food cravings found it to be in a direction contrary to expectations (Harvey, Wing & Mullen, 1993). The following section will provide a summary of the research investigating the relationship between dieting, weight loss and food cravings.

Much of the evidence on dieting and food craving has been based on experimental, cross sectional or short-term research studies. Whilst not using the term *food craving*, an early experimental study by Wadden and colleagues (1987) suggested that the link between dieting and subsequent *desire for food* was not as clear as previously thought. In an experimental investigation of obese individuals, hunger ratings of individuals assigned to receive a 500 calorie (limited protein) diet were compared to those assigned to a 1200 calorie balanced diet. Results found those in the reduced calorie diet actually reported less hunger than did those in the 1200 calorie condition. The finding was likened to the reduced hunger observed in eating disordered patients (Halmi & Sunday, 1991) and thought to represent a reduced *urge to eat*. Similarly, other studies of food cravings and appetite during very low calorie diets have evidenced comparable findings. Using a study-specific measure for recording cravings, Lappalainen and colleagues (1990) compared ratings of hunger and cravings in a sample of fasting obese participants to those of dieting obese participants, to find that the frequency of hunger and craving experienced reduced over a period of three weeks. Whilst both groups were observed to show a reduction in responses, the changes in the fasting group were more marked. However, the study was potentially affected by the way in which ‘craving’ was defined to

participants- 'seeking something pleasant, e.g. pleasant mood' - and their subsequent understanding and reporting of food cravings. However, specificity of food cravings were not reported on due to high missing values. Further, although the decreases in craving frequency were more marked in the fasting group, there was also a higher demand on this group for recording and completing measures. Therefore, the reduction in cravings may reflect a decrease in compliance, rather than a true reflection of change in craving frequency.

In a development of this research, Harvey and colleagues (1993) monitored changes in cravings during a six month weight loss programme. Participants were obese individuals randomly assigned to a balanced, low calorie diet (1000-1500 kcal per day) or a food based very low calorie diet (400-500kcal per day; lean meat, fish and fowl only). Although having initially hypothesized that food cravings would increase in the very low calorie dieters, the researchers observed a decrease in food cravings in both dieting groups. Again, the decreases were more marked in those on the very low calorie diet and were most pronounced for the 'allowed' food types within the diet protocol. Although the study made efforts to capture detail on the specificity of food cravings, there was no mention of the frequency and intensity of the craving experience, and the question 'to what degree have you wanted to eat the following foods?' is again open to interpretation as to whether this equates to food *craving*. However, Martin and colleagues (2006) used the Food Craving Inventory in a sample of obese participants and found similar results. Over an 11 week period, participants following a supplement-based very low calorie diet showed marked decreases in food cravings compared to those on a food based low calorie diet.

Interestingly, the researchers noted that the change in cravings was not associated with weight loss across the observation period.

However, other studies in this area have provided results to the contrary. Coelho and colleagues (2006) recruited a sample of undergraduate students to investigate the effect of short-term (three day) selective food restriction on subsequent food intake and cravings to find a food-specific rebound effect; participants engaged in carbohydrate or protein-restricted diets consumed more of, and experienced greater cravings for the restricted food type. A second study by Gilhooly and colleagues (2007) found no change in cravings over a period of six months in a sample of overweight women placed on energy restricted diets. As opposed to many of the other studies in this area, participants completed a measure of food craving that gathered information on frequency, specificity and strength of cravings. During the observation period, there were no significant changes in the quality of the craving experience. However, the researchers did report a significant decrease in the degree to which participants 'gave in' to food cravings.

In a variation of 'restricted' dieting, researchers have also evidenced cravings to increase for foods that differed in texture and sensory quality to those provided during the experimental period. In a study by Pelchat & Schaefer (2000), participants were placed on a nutritionally complete liquid diet for five days and food cravings were compared to a baseline rating. Overall, food cravings were found to increase during the experimental period. On the basis of this research, the authors suggested that cravings do not arise solely in the presence of nutritional deficits, but can be

triggered by placing individuals on monotonous diets with little or no variation. By this definition, 'typical' approaches to dieting within the general population such as adhering to strict, limited choice meals and food types may produce similar effects.

As evidenced, much of the research investigating the relationship between dieting and food craving has focused primarily on laboratory induced or diagnostic extremes of eating behaviour - participants have been required to completely eradicate food types from their diet, been placed on artificial liquid diets or restrict energy intake to unsafe levels. Whilst these studies have provided some insight into the nature of food intake and food cravings, it remains difficult to reliably transfer this knowledge on to typically observed dietary strategies. In order to manage or lose weight, the majority of individuals will engage in some form of dietary restriction, be that through cutting back on treats, limiting alcohol, or skipping meals. For others, efforts to lose weight are supported through commercial slimming clubs, which similarly promote replacing normal meals with low calorie replacements (Slim-Fast), limit food 'points' through the day (Weight Watchers), restrict or even cut out specific food groups altogether (Rosemary Conley/Atkins). In this sense, most weight-loss strategies will contain a certain element of dietary and cognitive restriction, and we might assume from the psychological account of food cravings that individuals would therefore experience an increase in food cravings. However, research investigating food cravings in samples of women engaged in such dietary strategies remains inconclusive.

A recent study by Massey & Hill (2012) is an example of food craving experiences in a sample of non-clinical women. The researchers used a quasi-prospective design, whereby 129 women were asked to complete a food craving questionnaire immediately following each food craving experience over a seven day period. Participants were asked to rate their mood and hunger following the craving, and provide a retrospective account of mood and hunger in the period before the craving experience. Participants were also asked to classify themselves as 'dieting to lose weight', 'watching what I eat so I don't gain weight' or 'not dieting'. On examination of the results, the researchers found that individuals 'dieting to lose weight' reported more cravings than the other two groups. Participants watching what they ate were found to experience more food cravings than did those not currently dieting. Of interest, the group dieting to lose weight experienced cravings in the context of low hunger and in the absence of dysphoric mood. Whilst this was a promising account of the variation in cravings between individuals of varying degrees of dietary regulation, the study did not ascertain whether there was any weight change over the period or the contribution of weight change to the food craving experience. An important consideration is whether dietary measures to lose weight (i.e. calorific depletion) have different physiological and psychological effects on those of a healthy weight when compared to individuals with BMIs much higher than the recommended norms (Meadows, 2012). Although those in the 'dieting to lose' group had a mean BMI that was placed at the 'overweight' category, the sample did not include any 'obese' or 'morbidly obese' individuals. Therefore, similar research is needed to determine whether there is any change in cravings associated with weight loss, and whether the same pattern of difference would be found in a sample of overweight or obese individuals.

Long term studies of food cravings in people engaged in weight management strategies have tended to be pharmaceutical trials of weight-loss in obese populations such as the Contrave Obesity Research I (COR-I) study (Greenaway et al., 2010). Using the Control of Eating Questionnaire (COEQ), Greenaway and colleagues monitored cravings in an obese sample of participants across a 56 week period, with an interim measurement at 8 weeks into the weight loss programme. All participant groups were observed to show a decrease in the reported frequency, intensity and specificity of food cravings across the study period, the greatest changes occurring during the first 8 weeks of weight loss. Although food craving is not the main outcome of interest for the researchers, the results of such studies have nevertheless provided additional information on the relationship of food cravings, dieting and weight loss.

In an effort to directly assess the relationship between weight loss and change in participant's experience of food cravings, Batra and colleagues (2013) sampled directly from individuals engaged in weight loss intervention programme and used a comprehensive battery of assessments to measure food cravings and eating behaviour. Over a period of six months, the study found significantly greater craving reductions in those randomised to the programme compared to wait-listed controls. The researchers also report on the relationship of trait-craving to weight loss, suggesting that those scoring higher on the FCQ-T at baseline showed smaller subsequent weight change. Whilst certainly a promising development in researching the contribution of cravings to weight regulation, the treatment arm of the study also

included a cognitive-behavioural element, offering regular group-based mindfulness and acceptance-based strategies for coping with food cravings; the subsequent findings may therefore not be representative of the effects of dieting in typical weight loss programmes.

3.4 Summary of Research

Food cravings have been associated with poor weight-outcomes (Abilés, Rodríguez-Ruiz, Abilés, et al., 2010) and a loss of control over eating (Moreno, Warren, Rodríguez, et al., 2009). Theoretical explanations of food cravings have suggested that the experiences arise as a consequence of physical and psychological attempts to regulate food intake (Rogers & Smit, 2000). Whilst cross sectional studies have provided evidence of a correlation between dieting, weight loss and cravings, prospective research investigating the relative change in craving experiences during a period of managed weight loss is extremely limited. Further, evidence as to the direction of change in craving experiences during weight loss is equivocal (Hill, 2007); what research has been conducted has tended to focus on dietary extremes, have been performed under laboratory settings and dietary changes have been relatively short-term. Further, the few long-term studies of dieting and weight change that have included craving as an outcome measure have been in the context of weight management studies. This means that the focus of the research was on weight loss, rather than having a detailed focus on craving and the relationship of this construct to weight change. There is therefore a pressing need for further research to be conducted with individuals involved in weight management, using

clearly defined constructs of cravings and dieting, and prospective evaluation of craving *change* during weight loss.

3.5 *Principal Research Question*

The aim of the present study was to investigate the experience of food cravings within a sample of people enrolled with a commercial slimming company; to explore participants' perceived change in their experience of food cravings during a period of active weight management. The study provided an extension to previous research (Massey & Hill, 2012) by exploring the influence of self-classification of dietary behaviour on craving experiences during active weight-management within a community setting, whilst the longitudinal design of the study allowed for further examination of how changes in craving experience are related to the amount of weight lost.

3.5.1 *Hypotheses*

It is hypothesized that:

i) There will be a difference in the frequency/intensity of food cravings between people self-classified as 'dieting in order to lose weight' and 'watching in order to not gain weight'. Specifically, individuals 'dieting to lose weight' will experience more food cravings than those 'watching what they eat in order to maintain their weight'.

ii) Overall, in a group of people engaged in weight management, food craving experiences will increase over the period of observation.

iii) However, there will be a positive relationship between the amount of weight lost over the study period and the change in the frequency/intensity of food craving experiences over the same period; greater amounts of weight loss will coincide with greater increases in reported cravings.

METHOD

4.1 Design

The study design was longitudinal, using 2 discrete periods of data collection. A follow up period of seven weeks was selected based on the observation of Greenaway and colleagues (2010) that the most significant changes in cravings occurred across a similar period of observation. The research questions were addressed by cross-sectional analysis at time 1, and by longitudinal analysis looking at the change in scores between the two time points. Further detail of statistical analyses used is provided below.

4.2 Participants

Participants were recruited by virtue of their membership with the weight-management organisation Slimming World (SW), and were not offered any financial incentive for taking part in the study. Agreement and support for the research was obtained from SW head office; the research was conducted with the approval of the head of nutrition and research and with support from the public health manager. A notice about the study was placed on the front page of the SW members-only website, briefly outlining that members were invited to complete a survey looking at experiences of food cravings during weight loss.

Power analyses were performed using the statistical program G-Power. To investigate the direction of relationship between changes in weight to changes in cravings, a bivariate correlation with a power of 0.8 would require 84 participants

with data at both time points. As outlined, a regression model may be used to explore the relative contribution of baseline craving when explaining the variance in weight change at the second time point. A priori calculation of sample size suggests approximately 73 participants would need to be entered into the analysis to obtain a power of 0.8. To investigate the interaction between dieting classification and cravings, multivariate analysis of variance would be used. A priori calculation of sample size suggests approximately 149 participants would need to be entered into the analysis to obtain a power of 0.8.

Ethical permission for the study was granted by the Faculty of Medicine and Health at the University of Leeds (see Appendix 2).

4.3 The Survey

The questionnaires required for data collection were integrated onto an online survey (Bristol Online Surveys, BOS). The service allows users to develop and deploy surveys whilst simultaneously storing the responses. In order to manage data collection, it is possible to employ ‘open’ and ‘close’ dates outside of which it would not be possible to access the survey. By clicking on an embedded link on the Slimming World website, potential participants could be transferred to the front page of the study survey (hosted by BOS). This page provided participants with the study-relevant information necessary for them to make an informed decision about participation (see Appendix 3 for a screen shot of the information page) and outlined eligibility criteria (currently engaged in active weight management through SW). After providing potential participants with information, the next page included

statements to ensure that they were completing the survey with informed consent, and with the understanding of how their data would be used and their right to withdraw their data by providing a membership number to the researcher (see Appendix 3 for a screen shot of the consent page). Two versions of the survey were created. The first survey differed in that it gathered additional information about respondent's health conditions and any prescribed medication, in addition to the standardised questionnaires.

4.4 Measures

4.4.1 Demographic Information: SW membership number (used to link responses to weight-loss data); date of birth (used to calculate age and in order to ensure that correct information could be obtained should the participant enter their membership number incorrectly); gender (used to describe sample); height (used to calculate BMI); health condition for which taking medications (and list medication where relevant). Postcodes were provided in order to assess socio-economic status of the sample and to ensure that responses were drawn from a representative sample of the population. The English Indices of Deprivation measures levels of 'multiple' deprivation (IMD) in England; the higher the score the more deprived an area is. IMD scores for the sample were calculated using the programme GeoConvert (accessed from <http://geoconvert.mimas.ac.uk/>), an online tool that allows users to convert and match different levels of geographic areas in England and Wales.

4.4.2 *Control of Eating Questionnaire – 7 day version (COEQ)*: The Control of Eating Questionnaire is a 21-item measure of the frequency, intensity and specificity of food cravings over a specified time period. The main elements incorporated into the COEQ have been derived from the craving record used by Waters and colleagues (2001) and Massey & Hill (2012). Two versions of the COEQ are available, single day or previous seven days. In the current study, participants rated their craving experiences over the last seven days in order to reflect the rating period used by the other outcome measures. This included questions about frequency, strength and specificity of food cravings, and appetite and affective state across the same time period. All questions utilised an eleven point rating scale from 0 (not at all) to 10 (extremely/all the time). The COEQ has previously been used to measure food cravings in clinical trials investigating the efficacy of drug therapy in treating obesity (Greenaway et al, 2010; Wadden, Foreyt, Foster, et al, 2011). Examination of the psychometric properties of this assessment within the current study (Time 1, N=2932) shows it to have good internal consistency ($\alpha=.85$). Example screen shots and full questionnaires can be found in Appendix 4.

4.4.3 *Three-Factor Eating Questionnaire - Short Form (TFEQ-R18; Karlsson, Perrson, Sjöström & Sullivan, 2000)*: The TFEQ was selected for use in the current study as it has been widely used within the current cravings and weight control literature and considered to be better related to eating behaviour than other measures of restraint. The original 51-item version of the three factor eating questionnaire was developed by Stunkard & Messick in 1985. The psychometric properties of the revised 18-item version were found to be satisfactory with internal consistency estimates above the standard 0.7 level (Karlsson, Perrson, Sjöström & Sullivan,

2000; Anglé, Engblom, Eriksson, et al, 2009). The 6 questions from the restraint scale were used in the current study (N=2932) were found to have acceptable internal consistency at 0.61. Following previous research (Massey & Hill, 2012) and the work of Witt and colleagues (2013), an additional question was appended to this section for participants to self-classify themselves as ‘dieting to lose weight’, ‘watching what I eat so I don’t gain weight’ or ‘not dieting’.

4.4.4 Perceived Self-Regulatory Success of Dieting (PSRS; Fishbach, Friedman & Kruglanski, 2003): First utilised in a study investigating the effects of short-term temptation on goal driven behaviour, perceived self-regulatory success was found to be related to the ability to suppress temptations and activate goal driven behaviour. The use of this measure in the current study will provide further information on whether perceived success of dieting is related to craving frequency and weight change. The questionnaire consists of three questions asking participants i) how successful they have been in watching their weight ii) in losing extra weight and iii) how difficult they have found it to stay in shape. The measure has since been incorporated into studies of successful versus unsuccessful dieting (Meule, Westenhöfer & Kübler, 2011; Meule, Papies & Kubler, 2012). The psychometric properties of the scale have been investigated by Meule and colleagues (2012) by re-examination of data across 4 studies (N=632) with good internal consistency (0.73) and discriminant validity. A fourth question (‘How difficult have you found it to stick to your diet plan?’) was added to the scale by the current researcher in order to factor in the influence of having a set diet plan on perceived success, and participants were invited to identify their weight loss ‘target’ for that week.

4.4.5 *Depression Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995):*

The DASS was first developed as a 42 item self-report measure of anxiety, stress and depression. A review of the psychometric structure of the DASS reveals it to have adequate convergent and discriminant validity when tested against other measures of depression and anxiety, with good reliability coefficients (.91 & .84) in both clinical and non-clinical samples (Crawford & Henry, 2003). The psychometric properties of the DASS were evaluated by Antony and colleagues (1998) in both clinical and community samples and concluded that the short form scale was a robust measure of depression and anxiety with clear factor structure. A later study (Henry & Crawford, 2005) utilised the DASS to provide normative data across a large community sample (N=1,794) of the general UK adult population. Whilst other measures of anxiety and depression are available, the most commonly used scale (the HADS) is intended to exclude somatic symptoms that might be more reflective of a physical condition rather than psychological distress, and developed for use in hospital settings, and is more closely aligned with generalised anxiety disorder. The DASS, on the other hand, reflects feelings of panic and physical symptoms, and also includes a third facet of general 'stress'. In the original manual, Lovibond & Lovibond (1995) suggest that the DASS can be reliably shortened to a 21-item scale, and it is therefore included as a low-demand and psychometrically reliable measure of psychopathology in the research sample.

4.4.5 *Weight Data:* Slimming World provides all members with a 'smart' card when they join a group. It is unique to each individual, and includes a chip containing personal information, weight data and a record of attendance. The card stores information securely on a centralised database which provides access to a

member's records and details such as their weight loss history and contact details. Following completion of the first survey, SW member numbers were sent to the company, along with each participant's date of birth and gender to facilitate cross-matching. The file was returned complete with participant's postcode, SW start date and weight data held for the individual at the time of joining SW, at the start of the study, and weekly weight data thereafter for a period of seventeen weeks.

4.5 Procedure

In collaboration with SW web designers, an advertisement was posted on the members' only webpage which contained a link to the online survey information sheet. Participation in the study occurred when members transferred through the consent page and on to the first questionnaire section. The link was placed on the members' webpage for a period of fifteen days. In order that participants could receive an invitation email to participate in the second part of the survey, the last page allowed participants to provide their email addresses if they consented to doing so.

Seven weeks after the first survey was launched, participants providing an email address were sent an email containing a link to the second survey. Provision of the link by email was in order to ensure that only participants completing the first survey were providing data for the second survey. A further reminder email was sent out a week after the first invitation. The second survey remained open for a period of four weeks.

4.6 *Data Analysis*

The BOS program captures and stores data on a secure server as a .csv file (comma separated values) compatible with Microsoft Excel. Data were integrated into the IBM SPSS Statistical programme (version 20) and analysed. Responses retrieved from the BOS website were checked against information held by SW (Date of Birth, ID number, gender) to verify respondents. SW membership number was used to identify 'duplicate' cases and remove the incomplete survey entry for these individuals. Thereafter, respondents were filtered according to i) those with weight data within 2 weeks of survey completion and ii) those with complete COEQ, TFEQ, PSDS and DASS questionnaires. As the survey had been accessible by all SW members, data were also filtered to adhere to agreed ethical inclusion criterion and those aged below eighteen years of age were removed. Preliminary analyses found no significant differences between males and females on outcome measures, and responses were combined.

All variables were examined using histograms, estimations of skewness, kurtosis and the Kolmogorov-Smirnov test to check for accuracy of data, missing values and fit between variable distributions and the assumptions of multivariate analysis. Results were checked and considered not to violate the assumptions of normality. Therefore, parametric methods were used for data analyses.

Multivariate analyses of variance were conducted to examine the differences between self-classified groups in terms of baseline demographics and characteristics, craving experience, restraint, perceived success of dieting and mood, controlling for

BMI at study completion, gender and age. In addition to these covariates, the analysis of craving experiences also controlled for depression and dietary restraint. Linear regression analyses were conducted to i) examine whether baseline craving scores predicted changes in weight across the period of study and ii) explore whether change in craving scores across the study period was accompanied by change in weight across the study period. In order to explore the relationship between baseline craving experiences and weight loss over the study period, and to identify specific variables associated with weight change, correlation coefficients were examined; in order to determine the unique contribution of baseline craving measures in explaining the variance in overall weight change, a hierarchical regression model was employed adjusting for baseline BMI, age and psychopathology. To examine whether changes in weight over the study period were accompanied by similar changes in craving experience, change in weight during the period of observation was computed by subtracting Time 2 weight (kg) from Time 1 weight (kg). Thereafter, logistic regression analysis was used to identify the degree to which the variance in weight change was associated with change in craving experience.

RESULTS

5.1 Part I: Cross sectional analysis of cravings by weight management classification

5.1.1 Participants

Of the 3433 responses from individuals, weight data were available for 95% of the sample, of which 90% had completed all baseline questionnaire measures. Eight respondents were excluded from the analysis as they did not meet inclusion criterion for the study (under 18 years of age). A schematic representation of this process is shown in Figure 1.

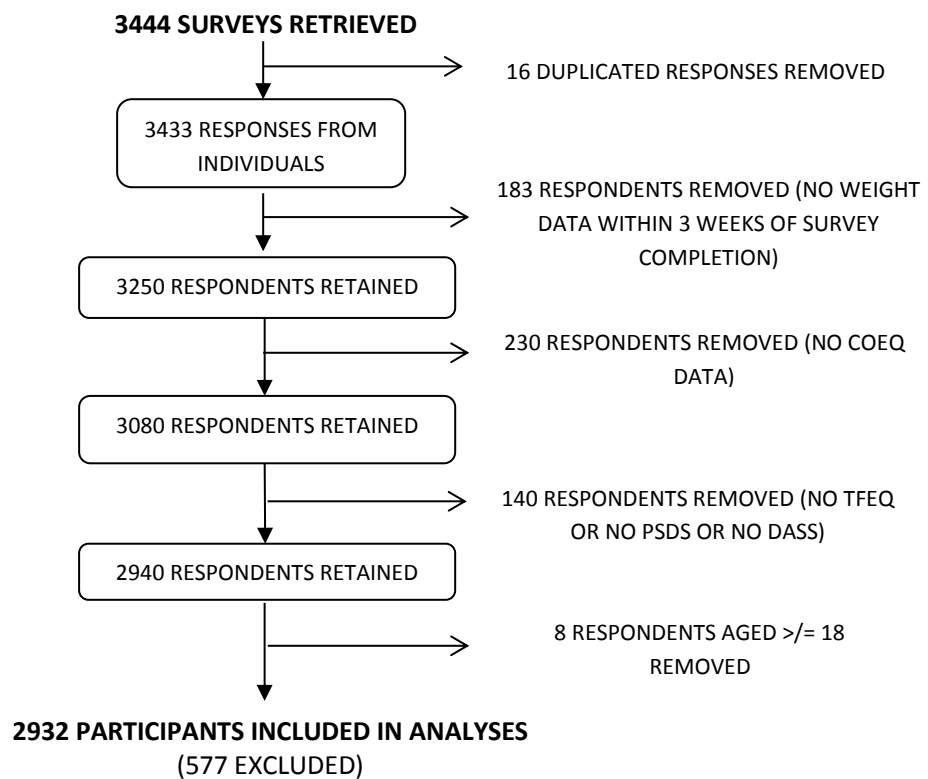


Figure 1: Flow chart of participant retention

The sample was predominantly female (n=2862, 97.5%), with approximately 43% of the sample identifying a health condition for which they were currently prescribed medication. The most commonly reported health condition was ‘mood/depression’ (n=389) followed by ‘hypertension’ (n=309) and ‘chronic pain’ (n=191). A full list of health conditions is provided in Appendix 4. The average age of the sample was 43.3, ranging from 18-91. Participants had on average held Slimming World membership for 39 weeks and had lost 9.48 kg from the time they joined to their completion of Time 1 questionnaires. The mean BMI of the sample at Time 1 was 31.6, ranging from 20 to 73. Using the classification of scores described by Lovibond & Lovibond (1995), the majority of the sample was within the ‘normal’ ranges for depression (66.5%), anxiety (81%) and stress (77.2%); however, a small proportion of the sample scored above the cut-off for ‘extremely severe’ depression (5.3%) and anxiety (3.2%).

Using the postcodes provided by participants, it was possible to examine the geographical spread of the sample. The majority of the sample lived in England and Wales, however a small proportion of the sample were from Scotland and Northern Ireland (see Figure 2).

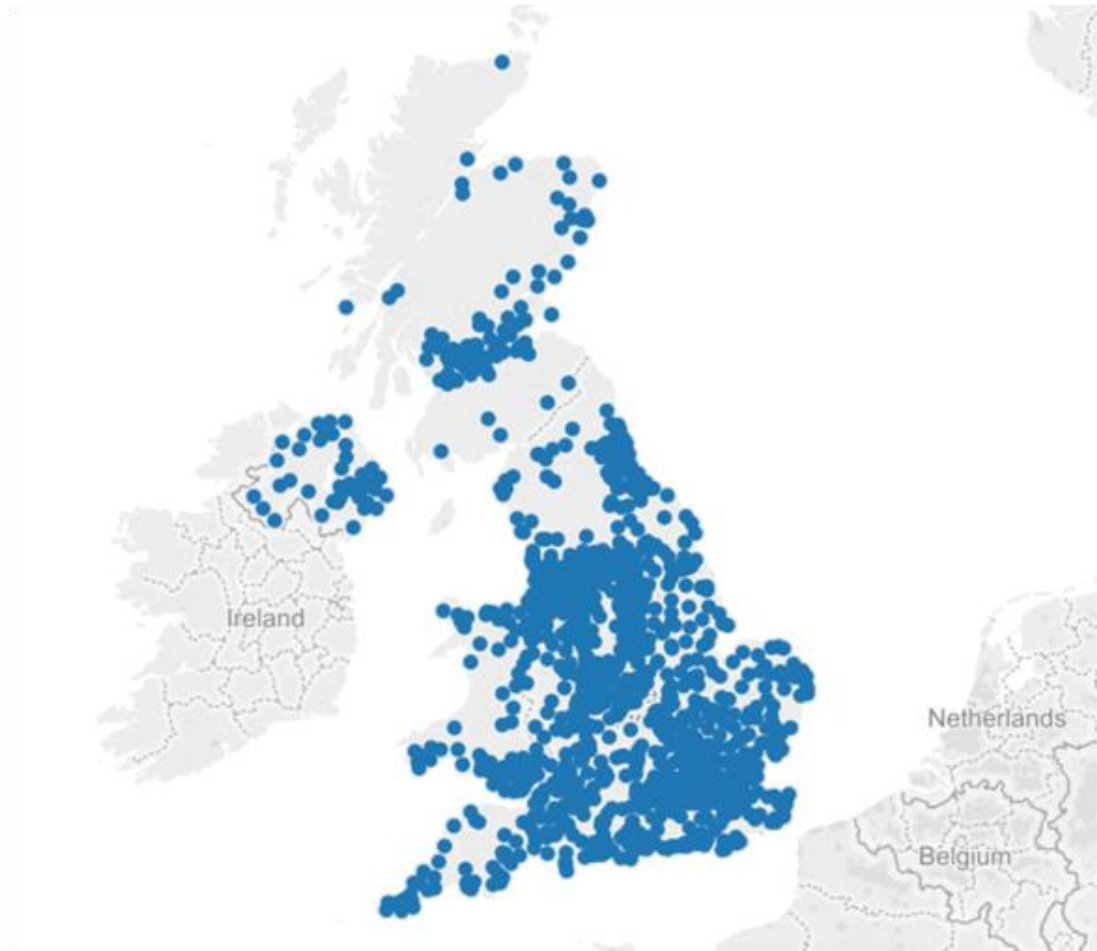


Figure 2: Geographical spread of participants

The mean Index of Multiple Deprivation (IMD) score for the sample was 20.37 (S.E.=0.30) compared to a national average of 21.67 (S.E.=0.09), (<https://www.gov.uk/government/publications/english-indices-of-deprivation-2010>).

The IMD scores were not normally distributed, therefore a median test was performed and confirmed that IMD scores for the current sample did not differ significantly from that of the national average ($p=.085$).

5.1.2 Group Differences

Participants were asked to indicate which of three categories best described their current dieting behaviour, ‘Dieting to lose weight’, ‘Watching what I eat in order not to gain weight’ and ‘Not Dieting’. Overall, 54.7%, 35.2%, and 10.1% respectively, self-classified in these categories.

Table 1: Demographic data (mean ± Standard Error;SE)

	Dieting (N=1603)	Watching (N=1033)	Not Dieting (N=296)	<i>Total Sample (N=2932)</i>
<i>Age (yrs)</i>	43.00 (0.30)	43.64 (0.41)	43.42 (0.68)	<i>43.26 (0.23)</i>
<i>Membership length (wks)</i>	32.96 (1.18) ^a	47.58 (1.98) ^b	42.68 (3.15) ^b	<i>39.04 (1.01)</i>
<i>SW start BMI(kg/m²)</i>	35.79 (0.19) ^a	33.77 (0.22) ^b	35.37 (0.43) ^a	<i>35.04 (0.14)</i>
<i>Study completion BMI(kg/m²)</i>	32.28 (0.17) ^a	30.02 (0.20) ^b	33.06 (0.42) ^c	<i>31.56 (0.13)</i>
<i>Weight change since joining SW (kg)</i>	9.60 (0.23) ^a	10.20 (0.30) ^a	6.30 (0.48) ^b	<i>9.48 (0.17)</i>

Means with different superscripts are significantly different to each other (p<.05)

There was a significant main effect of group on the demographic data ($F(2, 2926)=17.44, p<.001$), with univariate tests significant for BMI at study completion, BMI when joining SW, length of membership and weight change from joining SW to completion of Time 1 questionnaires ($F(2, 2926)=44.01, p<.001$; $24.83, p<.001$; $23.27, p<.001$; and $20.91, p<.001$ respectively; Table 1). The ‘Dieting’ group had been members for a shorter period than the ‘Watching’ and ‘Not dieting’ groups. Whilst the ‘Watching’ group had significantly lower BMI upon joining SW and upon study completion, the amount of weight lost from joining SW to study completion was comparable between the groups.

5.1.3 Dietary Restraint, Perceived Success of Dieting and Mood

All three groups showed significant differences in dietary restraint, as measured by the TFEQ, and in their self reported success of dieting ($F(2, 2924)= 109.8, p<.001$; $364.03, p<.001$). Post hoc analysis of group means (see Table 2) found the ‘Dieting’ group reported more restraint and higher perceived success of dieting than those in the ‘Watching’ group, who in turn reported more restraint and higher perceived success than those in the ‘Not Dieting’ group.

Table 2: Dietary Restraint, Perceived Success of Dieting, and psychopathology (mean \pm SE)

	Dieting	Watching	Not Dieting	<i>Total Sample</i>
Restraint	13.27 (0.07) ^a	12.52 (0.09) ^b	10.61 (0.17) ^c	12.74 (0.06)
PSDS	18.83 (0.12) ^a	16.83 (0.16) ^b	10.61 (0.32) ^c	17.29 (0.10)
DASS <i>Depression</i>	6.82 (0.20) ^a	7.54 (0.27) ^a	14.43 (0.62) ^b	7.84 (0.16)
<i>Anxiety</i>	3.78 (0.13) ^a	4.08 (0.18) ^a	6.73 (0.40) ^b	4.19 (0.10)
<i>Stress</i>	9.16 (0.19) ^a	9.62 (0.26) ^a	14.73 (0.54) ^b	9.89 (0.15)

Means with different superscripts are significantly different to each other ($p<.05$)

Groups also differed in their reported levels of depression, anxiety and stress at Time 1 ($F(2, 2924)= 98.87, p<.001$; $34.44, p<.001$; $57.34, p<.001$), such that those engaged in active weight management reported lower levels of psychopathology than those self-classified as ‘Not Dieting’.

5.1.4 Control of Eating Questionnaire

There was a significant main effect of group on the craving experiences of participants ($F(2, 2922)=50.83, p<.001$), with univariate tests significant for how

often, how strong, how difficult to resist the cravings were ($F(2, 2922)=35.79$, $p<.001$; 36.23 , $p<.001$; and 55.88 , $p<.001$, respectively), how often participants were eating in response to cravings ($F(2, 2924)= 200.63$, $p<.001$), and their difficulty controlling cravings ($F(2, 2924)=174.12$, $p<.001$). As displayed in Table 3, post hoc analysis found groups to fall into three distinct homogenous subsets on all five items. Across all questionnaire items, the ‘Dieting’ group reported significantly fewer, less intense and more easily controlled craving experiences. The ‘Not Dieting’ group reported the most frequent, strong and most difficult to resist experiences, with the ‘Watching’ group placed midway between the other two.

Table 3: Craving Experience (mean \pm SE)

	Dieting	Watching	Not Dieting	<i>Total Sample</i>
<i>How often have you had food cravings</i>	5.20 (0.06) ^a	5.60 (0.08) ^b	6.92 (0.13) ^c	5.52 (0.05)
<i>How strong have food cravings been</i>	5.90 (0.06) ^a	6.34 (0.08) ^b	7.56 (0.12) ^c	6.22 (0.05)
<i>How difficult to resist</i>	5.72 (0.07) ^a	6.45 (0.09) ^b	7.98 (0.12) ^c	6.20 (0.05)
<i>How often eaten in response</i>	3.67 (0.07) ^a	5.12 (0.09) ^b	7.54 (0.14) ^c	4.57 (0.06)
<i>How difficult to control</i>	4.40 (0.06) ^a	5.21 (0.08) ^b	7.82 (0.12) ^c	5.04 (0.05)

Means with different superscripts are significantly different to each other ($p<.05$)

There was a significant main effect in relation to the reported frequency of cravings for specific food types ($F(2, 2922)=9.17$, $p<.001$). Univariate tests suggested groups differed in the frequency of cravings for chocolate, ‘other sweet’, starchy and savoury food groups ($F(2, 2922)=23.43$, $p<.001$; 30.93 , $p<.001$; 11.93 , $p<.001$; and 15.59 , $p<.001$, respectively). As evident in Table 4, post hoc analysis of food items craved showed that for ‘chocolate’ and ‘other sweet’ foods, all three dieting groups

formed distinct subsets such that the ‘Dieting’ group experienced fewest cravings, followed by ‘Watching’ and ‘Not Dieting’. For ‘starchy’ and ‘sweet’ foods however, the two groups engaging in active weight management experienced fewer cravings than those ‘Not Dieting’. An important exception to this pattern was the absence of any differences between the groups in their reported cravings for fruit/fruit juices and in their cravings for dairy, suggesting that the ratings did not simply reveal a generalized pattern of dieters reporting fewer cravings.

Table 4: Frequency of Food Cravings for different food types (mean ± SE)

	Dieting	Watching	Not Dieting	<i>Total Sample</i>
<i>Chocolate</i>	5.05 (0.09) ^a	5.70 (0.11) ^b	6.92 (0.18) ^c	5.47 (0.06)
<i>Other Sweet Foods</i>	5.07 (0.08) ^a	5.78 (0.11) ^b	7.08 (0.18) ^c	5.53 (0.06)
<i>Fruit/Fruit Juice</i>	2.14 (0.07)	2.13 (0.09)	2.04 (0.15)	2.20 (0.05)
<i>Dairy</i>	2.98 (0.08)	2.99 (0.09)	3.06 (0.17)	3.00 (0.06)
<i>Starchy</i>	3.68 (0.08) ^a	3.67 (0.10) ^a	4.87 (0.19) ^b	3.80 (0.06)
<i>Savoury</i>	3.79 (0.08) ^a	3.80 (0.10) ^a	5.18 (0.20) ^b	3.93 (0.06)

Means with different superscripts are significantly different to each other (p<.05)

Groups differed significantly in general levels of reported appetite and satiety at Time 1 ($F(2, 2922)=15.84, p<.001$), with specific differences in reported levels of hunger, fullness, desire to eat sweet and savoury foods ($F(2, 2922)=36.81, p<.001$); 7.19, $p=.001$; 31.27, $p<.001$; and 11.43, $p<.001$, respectively). Grouping the responses according to observed means, those engaged in active weight management formed a separate group to those ‘Not Dieting’ in terms of overall hunger and fullness, such that they were more ‘full’ and less ‘hungry’ over the past 7 days (see Table 5).

Table 5: Appetite and satiety ratings (mean ± SE)

	Dieting	Watching	Not Dieting	<i>Total Sample</i>
<i>How hungry have you felt?</i>	4.28 (0.60) ^a	4.41 (0.74) ^a	5.70 (0.15) ^b	4.47 (0.05)
<i>How full have you felt?</i>	6.83 (0.05) ^a	6.73 (0.62) ^a	6.37 (0.13) ^b	6.75 (0.04)
<i>How strong a desire to eat sweet foods?</i>	5.95 (0.07) ^a	6.53 (0.09) ^b	7.75 (0.14) ^c	6.33 (0.54)
<i>How strong a desire to eat savoury foods?</i>	5.12 (0.07) ^a	5.07 (0.09) ^a	6.10 (0.17) ^b	5.20 (0.05)

Means with different superscripts are significantly different to each other ($p < .05$)

When food cravings for sweet/savoury foods were explored, cravings for sweet foods were experienced most by the ‘Not Dieting’ group, followed by the ‘Watching’ and then ‘Dieting’ group. A different pattern emerged in relation to cravings for savoury foods, which suggested those ‘Not Dieting’ experienced more cravings for savoury foods than those engaged in weight management, but there was no differences between those ‘Dieting’ and ‘Watching’.

There was a significant main effect of group on ratings of mood ($F(2, 2902)=7.51$, $p < .001$), with univariate analyses finding significant differences on reported happiness, and also how alert and content participants felt at Time 1 ($F(2, 2902)=12.08$, $p < .001$; 19.35 , $p < .001$; and 21.47 , $p < .001$, respectively), and a trend to groups differing in reported levels of anxiety ($F(2, 2902)=2.97$, $p = .05$). As displayed in Table 6, post hoc analysis found two distinct subsets, with the weight management groups reporting a consistently more positive mood state than those in the ‘Not Dieting’ group.

Table 6: State Mood (mean ± SE)

	Dieting	Watching	Not Dieting	<i>Total Sample</i>
<i>How happy have you felt?</i>	6.74 (0.05) ^a	6.50 (0.07) ^a	5.14 (0.15) ^b	6.50 (0.04)
<i>How anxious have you felt?</i>	3.74 (0.07) ^a	3.98 (0.09) ^a	4.72 (0.17) ^b	3.92 (0.05)
<i>How alert have you felt?</i>	5.53 (0.05) ^a	5.32 (0.07) ^a	3.96 (0.13) ^b	5.29 (0.41)
<i>How contented have you felt?</i>	6.43 (0.06) ^a	6.28 (0.07) ^a	4.58 (0.15) ^b	6.19 (0.05)

Means with different superscripts are significantly different to each other ($p < .05$)

5.2 Part II: Investigating weight change and change in craving experiences during active weight management

5.2.1 Participants

Of the 2932 participants completing the Time 1 questionnaires, 54.3% (n=1591) completed Time 2 questionnaires. Survey responses were linked using the SW membership number as reference¹. Of the 1591 participants completing Time 2 questionnaires, 82.1% had provided an accurate SW membership number allowing responses to be matched. Eighty two participants were excluded from the analysis due to having no weight data available within seven days either side of questionnaire completion. In total, 1225 participants with weight and questionnaire data at both time points were included in the final analysis (Figure 3).

¹ Participant numbers were matched using Microsoft Excel. For participants whose data from the second questionnaire were not imported using this approach, membership numbers were i) scanned manually to identify those which had failed to match due to additional spaces, ii) attempts were made to utilise DOB data to identify those participants where more than one number on the eight digit membership number were incorrect and iii) attempts were made to match membership numbers by 'search and find' strings of first/last four digits of the number. Due to the number of permutations possible from an 8 digit number, further efforts to match numbers would not be feasible.

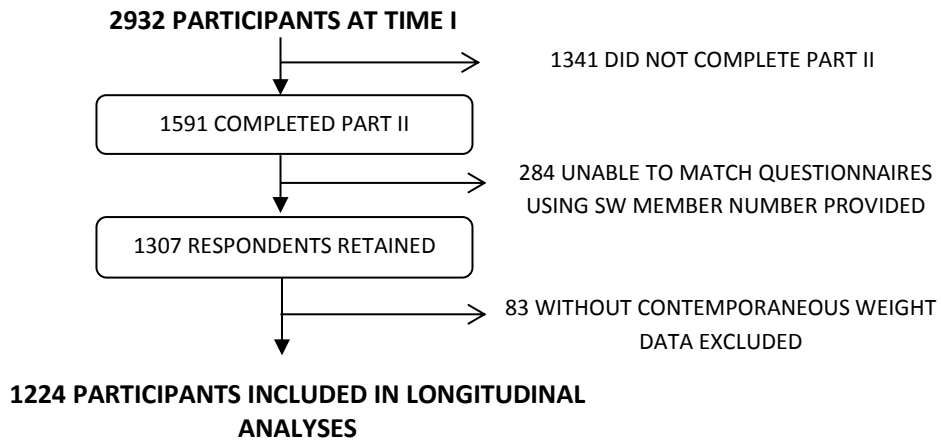


Figure 3: Flow chart of participant retention

There was a mean follow up duration of 7.3 weeks. The sample was predominantly female (n=1197, 97.8%) with a mean age of 44.8. The mean weight of the sample at Time 1 was 84.9kg and 82.9 at Time 2 with a mean weight loss of 2.0kg for the overall sample. The change in weight was significant at the $p=0.01$ level ($t=26.07$, $p<.001$). Figure 4 displays the downwards shift in weight distribution from Time 1 to Time 2.

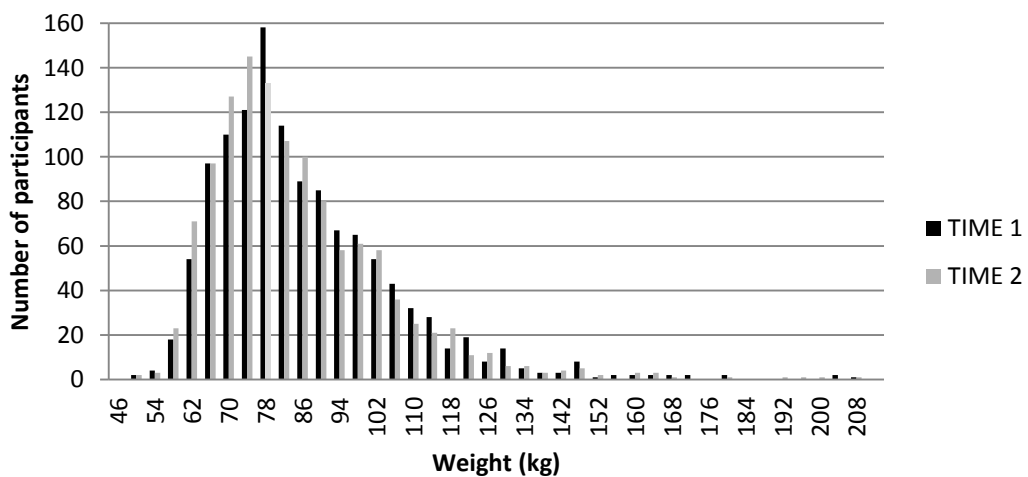


Figure 4: Histogram of weight (kg) at Time 1 and Time 2

Those included in the second phase of analysis were found to be older ($M=44.86$, $SE=.34$) than those not included (42.12 , $SE=.30$), $t(2930)=-6.02$, $p<.001$. There were no significant differences in BMI, frequency of cravings or in measures of psychological wellbeing between completers and non completers based on questionnaire scores at Time 1.

5.2.2 Changes in outcome measures between time points for whole sample

The main effect of ‘time’ on the change in outcome measures between Time 1 and Time 2 was investigated across the whole sample using a repeated measures multivariate analysis of variance. Due to the observed differences between self-classification groups on Time 1 data, the interaction between ‘time’ and ‘self-classification’ was also explored. Results are described below.

5.2.2.1 Psychological wellbeing, dietary restraint and perceived success of dieting

During the period between the completion of questionnaires at Times 1 and 2, there was a main effect of ‘time’ on measures of psychological wellbeing, dietary restraint and perceived success of dieting $F(5, 1217)=9.81$, $p<.001$. Univariate analyses revealed significant changes in participants’ scores on dietary restraint, depression and anxiety; participants were slightly less restrained in their eating at Time 2, and also scored lower on a standardised measure of depression and stress (see Table 7).

Table 7: Changes in psychological wellbeing for whole sample (N=1224)

	<i>Mean (S.E.) Time 1</i>	<i>Mean (S.E.) Time 2</i>	<i>F (1,1221)</i>	<i>p</i>
Restraint	12.79 (0.87)	12.27 (0.87)	4.42	.036
PSDS	17.82 (0.16)	17.06 (0.17)	4.90	.027
DASS <i>Depression</i>	7.23 (0.24)	6.25 (0.24)	40.56	<.001
<i>Anxiety</i>	3.79 (0.15)	3.56 (0.15)	2.60	.107
<i>Stress</i>	9.24 (0.23)	8.55 (0.23)	14.33	<.001

A significant interaction between ‘time’ and self classification of dieting at Time 1 was observed ($F(10, 2436)=9.02, p<.001$) on measures of restraint, perceived success of dieting, depression and stress ($F(2, 1221) =6.52, p=.002; 35.11, p<.001; 11.76, p<.001; and 3.99, p=.019, respectively$). Post hoc analysis suggested that those classified as ‘Not Dieting’ at Time 1 reported more dietary restraint and perceived greater success of dieting at Time 2.

However, when stability of self-classification of dieting was explored by comparing counts within each classification at the two time points, results suggested that those self-classified as ‘Not Dieting’ at Time 1 showed a greater degree of movement in their self-classification compared with those who were either ‘Watching what I eat’ or ‘Dieting’. The implications of such are considered in more detail in the discussion.

5.2.2.2 Control of eating questionnaire

There was a significant effect of ‘time’ on participants’ experiences of craving $F(5, 1217)=17.24, p<.001$. As described in Table 8, participants reported having less frequent experiences of cravings at Time 2 compared to Time 1; any cravings that were experienced were less intense, easier to resist and control, and less likely to lead them to eat in response.

Table 8: Changes in craving experience for whole sample ($N=1224$)

	<i>Mean (S.E.) Time 1</i>	<i>Mean (S.E.) Time 2</i>	<i>F (1,1221)</i>	<i>p</i>
<i>How often have you had food cravings</i>	5.42 (0.07)	4.83 (0.08)	48.17	<.001
<i>How strong have food cravings been</i>	6.19 (0.07)	5.31 (0.08)	76.30	<.001
<i>How difficult to resist</i>	6.13 (0.08)	5.43 (0.09)	59.37	<.001
<i>How often eaten in response</i>	4.49 (0.09)	4.28 (0.09)	39.09	<.001
<i>How difficult to control</i>	4.88 (0.08)	4.70 (0.08)	41.49	<.001

There was also a significant interaction between ‘time’ and self-classification over the study period $F(10, 2436)=9.64, p<.001$. Univariate analyses revealed significant differences in how difficult participants found it to resist cravings, how frequently they ate in response to cravings and how difficult cravings were to control ($F(2, 1221)=8.76, p<.001$; $29.11, p<.001$; and $29.70, p<.001$, respectively). Examination of post hoc results suggested that groups formed three distinct homogenous subsets in the degree of change between time points on how difficult cravings were to resist, how frequently the participant ate in response and how difficult they were to control. For these items, the ‘Not Dieting’ group were found to exhibit the largest decreases, with the ‘Dieting’ group showing the least and the ‘Watchers’ in between. For the intensity and frequency items, the groups formed two subsets, with those in active

weight management at Time 1 showing smaller decreases than those first classified as ‘Not Dieting’.

There was a main effect of ‘time’ on the reported cravings for specific food types between the two time points $F(6, 1216)=12.14, p<.001$, with univariate tests showing significant decreases in reported cravings for chocolates, sweet, starchy and savoury food types (see Table 9). The absence of change in either dairy or fruit is in keeping with findings from Time 1 data, in that these food types were rated as infrequently craved by the sample. There was no effect of self classification group in the amount of change found between the two time points.

Table 9: Changes in specific cravings for whole sample (N=1224)

	<i>Mean (S.E.) Time 1</i>	<i>Mean (S.E.) Time 2</i>	<i>F (1,1221)</i>	<i>p</i>
<i>Chocolate</i>	5.42 (0.10)	4.71 (0.10)	53.71	<.001
<i>Other Sweet</i>	4.43 (0.10)	4.09 (0.09)	19.17	<.001
<i>Fruit/Fruit juices</i>	2.25 (0.08)	2.41 (0.08)	3.93	.048
<i>Dairy</i>	3.11 (0.09)	2.96 (0.08)	0.44	.506
<i>Starchy</i>	3.68 (0.09)	3.36 (0.09)	10.45	.001
<i>Savoury</i>	3.67 (0.09)	3.41 (0.09)	16.23	<.001

Significant changes were found in measures of appetite and satiety (see Table 10).

There was a main effect of time $F(4, 1218)=10.87, p<.001$, with univariate analysis showing significant changes in hunger and desire to eat sweet or savoury foods ($F(1, 1221)=11.50, p=.001$; $38.86, p<.001$; $10.36, p=.001$, respectively). Over the period of study, participants reported that their perceived level of overall hunger was lower at Time 2 than at Time 1, and that their desire to eat savoury and sweet foods had reduced.

Table 10: Changes in appetite and satiety for whole sample (N=1224)

	<i>Mean (S.E.) Time 1</i>	<i>Mean (S.E.) Time 2</i>	<i>F (1,1221)</i>	<i>p</i>
<i>How hungry have you felt?</i>	4.34 (0.07)	4.02 (0.08)	11.50	.001
<i>How full have you felt?</i>	6.75 (0.06)	6.75 (0.06)	0.11	.745
<i>How strong a desire to eat sweet foods?</i>	6.18 (0.08)	5.65 (0.08)	38.86	<.001
<i>How strong a desire to eat savoury foods?</i>	5.05 (0.08)	4.80 (0.08)	10.36	.001

The effect of self classification on reported hunger was significant at the $p < .05$ level ($F(8, 2438) = 11.13, p = .044$), with the ‘Not Dieting’ group showing greatest reductions across the study period.

Across the whole sample, there was a significant change in state mood between the two time points, $F(4, 1204) = 47.27, p < .001$, with significant univariate tests across all items (see Table 11). The observed changes were in keeping with the changes observed in the DASS, that is, participants reported feeling happier, more content and less anxious.

Table 11: Changes in state mood for whole sample (N=1224)

	<i>Mean (S.E.) Time 1</i>	<i>Mean (S.E.) Time 2</i>	<i>F (1,1221)</i>	<i>p</i>
<i>How happy have you felt?</i>	6.65 (0.06)	6.78 (0.07)	10.37	.001
<i>How anxious have you felt?</i>	3.85 (0.08)	3.64 (0.08)	5.33	.021
<i>How alert have you felt?</i>	6.45 (0.06)	6.61 (0.06)	22.02	<.001
<i>How contented have you felt?</i>	6.41 (0.06)	5.71 (0.06)	27.51	<.001

There was also a significant interaction between time and self classified dieting status $F(10, 2436)=9.024, p<.001$, with significant univariate effects on how alert and how content people were ($F(2, 1204)=7.37, p<.001$; $7.06, p<.001$). Post hoc analysis suggested that the ‘Not Dieting’ group showed significantly greater increases in reported levels of alertness, whilst those self categorised as ‘Dieting’ showed biggest decreases in reported ‘contentedness’.

5.2.3 Relationship between craving experiences and weight loss

Of the craving items significantly correlated with weight change, baseline scores on the item ‘How often have you eaten in response to food cravings’ had a significant negative association with weight change in the regression analyses ($t= -6.133, p<.001$). Participant age, baseline BMI and baseline anxiety were also observed to be significantly related to weight change over the study period. Table 12 describes the contribution of ‘eating in response to cravings’ when predicting weight change across the period of study.

Table 12: Associations of baseline response to craving and weight change over the study period

<i>Regression Model^a</i>	<i>β</i>	<i>R</i>	<i>R²</i>	<i>Adjusted R²</i>	<i>F change</i>	<i>sig F change</i>
<i>1</i>	--	.219	.048	.046	30.61	<.001
<i>2</i>	--	.247	.061	.059	17.01	<.001
<i>3</i>	-.247	.363	.132	.129	99.90	<.001

^a Using participants’ behavioural response to cravings at time 1 (Eaten in Response) to explain variance in weight change after adjusting for baseline BMI, age and baseline anxiety; 1(baseline BMI & age), 2(baseline anxiety), 3 (‘how often eaten in response to food cravings’)

The model significantly explained 13.2% of the variance in weight change across the study period ($F(4,1218)=46.33$, $p<.001$). After adjusting for the contribution of baseline BMI, age and baseline anxiety, the frequency in which a person ate in response to food cravings explained 7.1% of the variance in overall weight change, such that individuals who more frequently ate in response to cravings at Time 1 showed less weight loss over the study period. Examination of regression coefficients for covariates suggested that individuals with higher BMI and lower anxiety at baseline, and were younger, lost greater amounts of weight during the study period.

Of the significant correlations between *changes* in craving experience and weight change, one item was significantly related to weight change in the regression model ('Generally, how difficult has it been to control your eating'; $t= 2.78$, $p=.005$). Results showed that, after controlling for baseline BMI and age, changes in weight across the study period were accompanied by changes in craving experience, such that those who lost greater amount of weight also reported a decrease in how difficult cravings were to control ($\beta=.119$, $t=4.24$, $p<.001$). The model explained 4.9% of the variance in weight change and was significant at the $p<.01$ level ($F(3, 1227)=22.00$, $p<001$).

DISCUSSION

To date, there is conflicting research evidence in the area of dieting and food cravings. Studies focusing on short-term weight loss or using an experimental design have found dieting to be associated with an increase in food cravings, whereas longer term observations have found a decrease. Further, research in this area has been hampered by inconsistent definitions and descriptions of what is meant by ‘dieting’ and ‘food craving’. The present study was designed in order to address both issues by i) asking participants to indicate their dieting *intentions* (weight loss vs. weight maintenance) ii) utilising a *detailed assessment* that focused on the key aspects of the craving experience iii) providing *cross-sectional* data on food craving experiences across the groups iv) exploring the *change in cravings* over a period of weight management and v) identifying the *associations* between food craving and weight change *over time*. It was hypothesized that individuals currently on a diet would report more cravings than those watching their weight, that cravings would increase over the period of observation and the increase in cravings would be associated with increased weight loss.

6.1 Summary of Results

6.1.1 Cross-sectional differences between ‘dieting’ groups

Cross sectional analyses were used to identify and compare differences in the craving experiences of individuals dieting to lose weight and those dieting to avoid weight gain. Whilst all participants reported moderate levels of food cravings, there were significant differences between ‘dieters’ and ‘watchers’ in terms of the frequency and intensity of food cravings, in how hard food cravings were to resist,

how often they ate in response to cravings, and in their perceived control over food cravings. However, the direction of the difference was in opposition to that hypothesised; individuals engaged in dietary strategies to lose weight reported *fewer* and *less intense* craving experiences than those ‘watching’ their weight.

Differences were also observed between groups in the *specificity* of reported food cravings. In contrast to previous research by Massey & Hill (2012), the direction of difference in the current sample was such that ‘dieters’ reported fewer cravings than those ‘watching what [they were] eating so not to gain weight’. Although this pattern was replicated for several typically craved food types (e.g. chocolate, sweets, savoury foods), this directionality was not found when cravings for fruit and dairy were examined. The presence of this exception would suggest that this was not due to a generalized response tendency for the ‘dieting’ group to report fewer cravings than the other groups. Further, these differences remained statistically significant after controlling for current weight, depression and reported dietary restraint; therefore, the observed differences were not due to the presence of shared variance with these constructs.

The study also gathered data from participants self-classified as ‘not currently dieting’ even though enrolled in a slimming organisation. When their craving experiences were compared to those of the two weight-management groups, the two dieting groups reported consistently lower ratings of craving frequency, intensity and specificity, and reported greater perceived control over eating. Further, the ‘not dieting’ group were found to have significantly higher levels of psychopathology

compared to those in the weight management groups. Unusually, the ‘not dieting’ group had the highest BMI at the start of the study, despite having been members of Slimming World equally or for longer than the other two groups. Although this group was not the main focus for the aims of the research, the presence of a ‘not dieting’ group within members of a commercial slimming organisation itself poses questions. Although Slimming World offers ‘target members’ free group membership for those who stay within three pounds of their target weight, only 12 participants classified as ‘not dieting’ at Time 1 fell into this category. A second possibility is that the ethos of Slimming World in ‘Food Optimizing’, rather than calorie or points counting, means some members do not perceive themselves to be ‘on a diet’. Further, as will be discussed in a later section, self-categorisation was assessed at both time points and found to change even over the course of seven weeks.

6.1.2 Craving change during active weight management

It was hypothesised that food cravings would increase over the period of observation (see section 3.5.1). However, the results of the present study found that over an average follow up period of seven weeks, a sample of individuals engaged in active weight management actually reported a *decrease* in the frequency and intensity of food cravings. Further, participants also reported that they were better able to control their food cravings, were less likely to eat in response and were better able to resist any cravings that they did have.

In order to identify whether these decreases were apparent across all weight management groups, multivariate analysis of variance were employed to determine any interaction effects between ‘group’ and ‘time’. Although those ‘dieting to lose weight’ did not differ significantly in the reported change in *frequency* and *intensity* of cravings compared to those ‘watching their weight’, there were significant differences in the degree of change in their perceived control of cravings, their ability to resist food cravings and their likelihood of eating in response to food cravings, such that the ‘watching’ group reported greater reductions in these aspects of the craving experience. One possible explanation of this pattern is *regression to the mean*, whereby those individuals reporting higher cravings at Time 1 reported less extreme scores at Time 2. However, it is also important to consider how the observed changes in self-classification status at Time 2 may have affected these results. On examining the shifts in dieting status across the two time points, there was a significant increase in individuals self-classified as ‘watching’ rather than the other two groups. It is therefore possible that the reported increase in control of eating occurred alongside the change in dieting status; as participants incorporated strategies to avoid gaining weight, they perceived themselves to have greater control or *behavioural inhibition* in response to food cravings.

Over the period of weight loss and weight management, there were also significant decreases in the levels of hunger reported by participants, suggesting that the dietary strategies were not translated into high perceived hunger by the participants. Further, the reduction in participant’s levels of hunger was not mirrored by increased levels of ‘fullness’, further reinforcing the notion that these are two distinct constructs - ‘fullness’ as one experienced as a physical sensation, whilst hunger as a more

nebulous indication of a general motivation to eat (Blundell, de Graaf, Hulshof, et al., 2010). This model was reinforced in the present study by the presence of a significant relationship between the change in levels of reported hunger and the change in participants' reported strength and frequency of food cravings, and is in support of similar research investigating change in cravings over a period of active weight management (Batra, Krupa Das, Salinardi, et al., 2013).

Participants self-classified as 'not dieting' at Time 1 also reported significant reductions in food cravings; the degree of change in the frequency and intensity of food cravings in the 'non-dieting' group was greater than those in the weight management groups. Similarly, this difference might be explained by regression to the mean or due to transition between classification groups between the two time points.

6.1.3 Association of change in weight and food cravings

The third research aim was to examine the relationship between weight loss and food cravings; it was expected that weight loss would be associated with an increase in food cravings. Contrary to this hypothesis, the study found that weight loss was not associated with changes in the frequency, intensity and specificity of food cravings, but with an increase in participant's perceived *control* over food cravings. As data were collected at two time points, it was possible to explore what aspects of the baseline craving experience were associated with changes in weight over the period of observation. After controlling for baseline BMI, age and dietary restraint, one feature of the craving experience 'how often have you eaten in response to food

cravings?’ explained a significant proportion of the variance in weight change; individuals who were less likely to eat in response to food cravings at baseline lost greater amounts of weight over the period of study.

The inclusion of the restraint subscale of the TFEQ allowed further delineation of the contribution of ‘dietary restraint’ versus momentary behavioural inhibition when explaining the variance in weight change. In accordance with previous research (Lowe et al, 2013), the present study found that the dietary restraint which would be typically expected of ‘dieting’ behaviour (e.g. not stocking up on certain foods, taking smaller portion sizes) was not significantly predictive of weight change. What *was* related to weight loss was the degree to which participants were able to inhibit a momentary motivation to eat in response to an immediate craving - the frequency with which any given craving experience resulted in eating the craved food. Whilst not an unexpected finding, it is of interest that there was also a significant increase in participant’s perceived ‘control of eating’ over the period of study. This might suggest the presence of an interaction between weight loss and participants’ appraisal of their ability to cope with - and resist - food cravings, such that increased weight loss directly affects how people perceive their ability to control and regulate food intake. However, the design of the present study does not enable inference of causality, and it may equally be true that changes in the individual’s appraisal of self-efficacy and control leads to weight loss success.

6.2 *Theoretical & Clinical Implications*

Through directly and purposefully sampling from a dieting organisation, the study allowed comparison of craving experiences to be made across weight management groups, and in contrast to previous research, found that dieting behaviour not only does not lead to an increase in food cravings, but is associated with a *reduction* in food cravings, even in the absence of any focused coping-based intervention.

Further, the study was able to identify the specific aspects of the food craving experience that were associated weight change

6.2.1 *Theoretical Implications*

The physiological theory of food cravings suggest that the experience arises as a result of caloric depletion, signalling the need for energy regulation. The current findings from a large, representative sample of individuals enrolled in a commercial weight management organisation contradicts this theory; those self-classified as ‘not dieting’ (i.e. not making attempts to reduce or regulate calorific intake) reported higher frequency of cravings compared to those dieting to lose weight. Using the ‘dietary restraint’ subscale of the Three Factor Eating Questionnaire, the study was also able to assess the contribution of dietary restraint when explaining the variance in weight change over the observation period. Although finding a small association between levels of reported restraint and food cravings across weight maintenance groups, dietary restraint was not a significant predictor of the variance in weight change. Further, dietary restraint was not related to the degree of perceived control over food cravings reported by participants. These results do not support the

hypothesis that high restraint leads to weight gain by virtue of increased food cravings.

Further, it was found that even in the context of moderate levels of food cravings, participants showed an overall *reduction* in weight over a relatively short period of time, and an increase in the reported ‘perceived control over food cravings’.

However, what *was* noted was the relationship between early behavioural inhibition in response to food cravings (‘how often have you eaten in response to food cravings?’) and participants’ weight loss success. One potential explanation of the link between dietary restraint, food cravings and weight change comes from the work of Muele and colleagues (2011) who have suggested two distinct styles of dietary control - rigid control, whereby efforts to completely abstain are made, and flexible control, which involves balanced strategies such as eating slowly or reducing portion size. Using a non-clinical sample, Meule and colleagues investigated the relationship between dietary restraint with cravings and weight loss and found flexible control to predict the individuals’ perceived ‘success’ of dieting. However, in analysing the results from the ‘unsuccessful’ dieters, the relationship between rigid control and weight loss was mediated by cravings, suggesting that it was the additional effect of craving that determined the degree of reduction in BMI.

Although this study used the trait version of the FCQ, which measures longstanding tendencies in relation to food and eating, a major subscale is ‘lack of control over eating’, a factor found to be significant in predicting weight change in the current research. Of further interest is the findings of Gilhooly and colleagues (2007), who also found that participant’s tendency to ‘give in’ to food cravings was a significant

predictor when explaining the change in weight during dieting. Together, the results of these studies might suggest a model of weight regulation such as that described in Figure 4, whereby those with high perceived control over food cravings and high momentary behavioural inhibition in response to food cravings are better able to regulate their weight. Success- or perceived ‘failure’ to address weight fluctuations thereafter affect the individual’s perceived control.

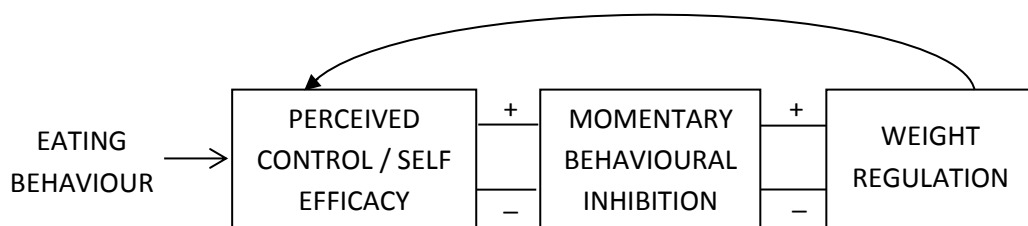


Figure 5: Hypothetical model of eating and weight regulation

Thus, early identification of individuals who struggle to inhibit behavioural responses to food cravings would signal the need for - and provision of - enhanced support packages.

6.2.2 Clinical Implications

The present study has identified a relationship between the ability of an individual to inhibit a momentary drive to eat a particular food and their subsequent degree of weight loss. Recent research investigating food cravings, dieting and weight loss has found interesting and promising results in developing support packages for

individuals struggling to cope with food cravings. Borrowing from cognitive behavioural theory, researchers have explored how *acceptance* based approaches and mindfulness can affect an individual's sense of personal control over food cravings. Using a similar follow-up period to the present study, Alberts and colleagues (2010) found that individuals provided with a seven week manual-based training program reported a greater reduction in their 'loss of control' over food cravings compared to individuals in a control group. In an extension of this work, Hooper and colleagues (2012) investigated how such approaches might translate into momentary behavioural inhibition in response to food cravings. Focusing specifically on cravings for chocolate after a period of abstinence, the study found that individuals instructed to use thought 'diffusion' (stepping back from thoughts, experiencing thoughts 'from a distance' and without implication for action) ate less chocolate in a laboratory experiment than those advised to suppress cravings for chocolate. Whilst the evidence in this area is relatively nascent, it nevertheless shows promise for future interventions for individuals having difficulty coping with food cravings.

The present study found that weight change was positively associated with mood such that weight loss was accompanied by similar reductions in levels of dysphoric psychopathology. However, analyses of results also revealed a relationship between baseline anxiety and minimal weight change; an association present by virtue of shared association with baseline BMI. Examination of results found that participants with a higher baseline BMI were more likely to be anxious, more likely to eat in response to food cravings and more likely to show minimal weight loss during dieting efforts. The link between baseline BMI and anxiety may be explained by looking at the weight loss history of the individual. In the present study, those with

higher levels of anxiety at baseline were those individuals who had lost the least amount of weight during their membership with Slimming World (prior to study commencement) and the anxiety may therefore be a reflection of their self-confidence or self-efficacy in weight management. There is, therefore, a potential opportunity for services to assess the individual's preparedness for weight change, and the degree to which they feel able to inhibit the desire to eat foods which will lead to weight gain. The addition of cognitive-behavioural interventions such as those described above have proven effective in recent studies, whereby those enrolled in a program that included acceptance based strategies observed a significant reduction in their 'lack of control over eating' compared to a control group (Batra et al, 2013).

6.3 Study Strengths, Limitations & Research Recommendations

To date, this is the first study that has purposefully sampled from a national population of individuals enrolled in a weight management programme and prospectively measured the relationship between weight change and food cravings. Whilst similar work has been completed in the United States (Batra et al, 2013), the 'lifestyle intervention' strategies incorporated into the study were designed for the purposes of the research and were constructed upon cognitive-behavioural approaches. The strength of the current study is that participants were recruited from an existing national commercial slimming organisation to which NHS patients are referred, and therefore provides a naturalistic setting from which to sample and further refine weight-loss interventions. Whilst this has provided further evidence to counter the 'restraint' account of food cravings, a number of questions remain which

may provide the necessary research rationale for further study. Discussion of the strengths, limitations and research recommendations is outlined below².

An important and novel aspect of the current study was the use of the Control of Eating Questionnaire (COEQ) to measure cravings across the period of study. As a specific measure of food craving, the COEQ measures appetite, food craving, eating behaviour, and mood over the 7 days prior to questionnaire administration. To date, there are few alternative measures developed that focus on the key aspects of the craving experience - namely the frequency, strength and specificity - in addition to gathering information on mood and general satiety. Consequently, the majority of the research into food cravings and dieting has used generic measures. By recruiting from a slimming organisation, the present study has provided a wealth of data ideal for examining the psychometric properties of the COEQ from a representative sample of the population. Support for the use of this measure when investigating cravings during weight loss comes from robust methodology and data from weight-loss trials. Randomised controlled trials utilising the COEQ have evidenced similar levels of *sensitivity to change* when investigating change in food cravings during drug-therapy (Wadden, Foreyt, Foster, et al, 2011), and have been shown to be evident over a similar observation period as the present study (Greenaway et al, 2010). Further, studies utilising the COEQ have found significant reductions when focusing specifically on participants' ability to control their eating and resist the food cravings, changes that were not observed on typically cited measures such as the

² In the process of completing this research, many important questions were raised about the nature and construct of 'food cravings', and importantly, the inherent difficulties in measuring subjective states. Further discussion about the nature-and limits- of knowledge within research is provided in Appendix 6.

Food Craving Inventory (Apovian, Aronne, Rubino, et al., 2013). An influential factor in the development of the current research study was the degree of variability in research findings when investigating the relationship between dieting behaviours, weight loss and food craving. A contributory factor to this is the lack of consensus on what measures should be used to define and measure food cravings in the general population. In order to develop a clear understanding of these relationships, and thereafter develop guidelines to support individuals engaged in weight management, a consistent approach to measuring food cravings would allow for reliable synthesis of results. Given the use of the COEQ in clinical trials, psychological studies utilising the measure in research, and the sensitivity of the questionnaire in measuring change, the COEQ could be considered as a viable tool with which to investigate the construct of 'food craving' and its relationship to weight change.

The present study followed a sample of participants in active weight management for a period of 7 weeks. Whilst statistically significant changes in weight were observed during this time, an average weight loss of 2kg meant that the resulting difference was relatively slight. However, the present study captured information from participants mid-way through a period of dieting. When overall weight loss since membership is considered, the sample had lost an average of 9.5kg over a period of 39 weeks. Whilst it may be possible for the study to be repeated over a longer period of time, over 20% of participants in the present sample lost 4kg during the observation period, a reduction in weight which is in accordance with recommended rates of weight loss (NICE 2006). Further, it is more likely that changes in weight loss would not show a linear trajectory when observed over an extended period, and

which would have implications for data analysis. The current study was able to collect weekly weights for some participants across a seventeen week period; however, outcome measures were only completed at two time points within this range which meant that the relationship between cravings and food could not be tracked against each other simultaneously. Although the present study used pre-determined groups of weight-management based on theoretical and empirical constructs (Lowe, Doshi, Katterman, et al, 2013; Massey & Hill, 2012) there were objective differences between members in their weight loss during the study period, and therefore a potential to refine groups according to *measured* weight change rather than their intended weight management strategy, as outlined below.

Latent Class Analysis (LCA) is a statistical method that allows for identification of unmeasured membership to a particular ‘class’ using categorical or continuous variables. In other words, this method of analysis allows the researcher to identify unobservable *subgroups* within a population. The use of LCA in relation to responses on the COEQ may also provide further insight into the types of cravings experienced by the population and in what context - for example those who might experience cravings in the context of low hunger that they eat in response to, compared to those who experience cravings in the context of low hunger that they feel able to control. Once classes are identified, LCA can be combined with other measures such as latent growth curve modelling which would provide information on trajectories of weight change in the groups identified. For example, over a longer period of time participants’ weight change may divide into those who steadily lose weight, those who remain the same, those whose weight increases and those whose

weight fluctuates. Exploring the craving experiences between classes in this way would provide more accurate understanding of the complex relationship between weight change and food cravings.

The present study was able to retain a sizable proportion (54.3%) of an already substantial sample size across a period of seven weeks. However, the method employed to match participant's responses was reliant on participants' accurate entry of their membership number into the online questionnaire. Therefore, a proportion of participant data was unable to be used in the analysis. Whilst efforts were taken to match respondents to their date of birth, the sheer volume of participants meant that many respondents had the same date of birth and where membership numbers were wholly different or missing, matching the questionnaires in this way was not possible. Alternative online-survey generators may enable researchers to track participants using other methods. The time-stamps on the questionnaires from the current study suggest that most participants completed the surveys outside of office hours, and therefore it is likely that they were completed from a home computer. Tracking participants' responses using a fixed, computer generated code such as IP address would therefore prove advantageous when matching follow up responses.

Whilst the present study did not gather information on participants' smoking status, previous research has found no differences in the food cravings reported by current smokers, non smokers and those abstaining (DiLorenzo, Walitzer, Sher & Farha, 1991), or those taking medication for smoking cessation such as Bupropion (Jain, Kaplan, Gadde, et al., 2002). Therefore smoking status was not considered to be a

significant factor in exploring change in cravings during weight loss. Further, the use of bupropion for smoking cessation in overweight and obese populations has not led to significant weight gain (Wilcox, Oskooilar, Erickson, et al., 2010). However, it is unclear as to whether there may be small differences in the *specificity* of craved foods in smokers versus non smokers. Extensions to the current research may wish to explore the identified differences from the COEQ in the *types* of foods craved by individuals ‘dieting to lose’ versus ‘watching’, and therefore use ‘smoking status’ as a covariate in the analyses.

As outlined, a major strength of this study was the provision of naturalistic, representative data of the relationship between dieting and food craving, and contrary to previous research found decreases in the food craving experiences of people engaged in weight management. Nonetheless, there were considerable differences in how individuals coped with and responded to their food cravings, and this led to variations in the amount of weight lost over a period of seven weeks. Given that recent research involving cognitive behavioural techniques has reported improvements in participants’ ability to control food cravings (Batra et al, 2013), and eat less in a controlled laboratory study (Hooper et al, 2012), the design of intervention studies using acceptance therapy in relation to food cravings may prove beneficial in determining the most effective support packages for weight loss groups. However, whilst this may be the desired outcome, further refinement of current knowledge is required; specifically, a study of the prospective, real-time relationship between weight loss and cravings during dieting, and the identification of latent classes with which to identify patterns of craving and weight change.

CONCLUSION

There are increasing numbers of people in the UK who are seeking help for obesity and related illness, and the government are keen to endorse strategies to encourage weight loss and healthy eating. There is a perception in the general public that dieting or ‘denying oneself of food’ will lead to an increased desire to eat, and many people cite food cravings as a reason for having difficulties when dieting. Although the literature in this area is conflicting, there is growing evidence that dieting does not necessarily lead to increased food cravings and that food cravings are also experienced by people who aren’t on a diet. There is therefore a need to explore the relationship between dieting and food cravings, and the relationship between food craving and dieting outcome. The present study has provided the first prospective study of cravings and weight loss in a purposively sampled population of individuals enrolled in a commercial weight loss organisation. The findings of the study add further weight to counter the restraint theory of food cravings and evidence to address lay concern that dieting behaviour leads to an increased desire to eat food. Given the mounting evidence against cravings arising *as a result of* dietary behaviour, there is now an increasing need to delineate how craving experiences can affect the individual’s *experience* of dieting. That is, to better understand the real-time relationship between craving and successful weight change and thereafter develop appropriate strategies for individuals struggling to cope with food cravings. As previously discussed, there is an increasing drive for health services to encourage healthy eating and weight loss. Although the government has introduced schemes to facilitate provision of weight loss interventions, retention is poor. Although food

cravings do not arise as a result of dieting, it remains a frequently reported explanation for non-adherence to dietary interventions. Further, difficulties in inhibiting momentary behavioural drives to eat the desired food have been found to contribute to weight change, and weight loss is associated with an increased sense of perceived control over food cravings. Given the promising research evidence in this area, weight-loss programmes should consider the provision of enhanced packages for individuals reporting a lack of control over food cravings. Psychological strategies such as acceptance based coping or mindfulness have been found to be effective; given the flexibility of such approaches in being adapted for group-based interventions, additions to existing programmes may offer a cost-effective way of reducing attrition rates and improving weight-regulation for the individual.

REFERENCES

Abilés, V., Rodríguez-Ruiz, S., Abilés, J., Mellado, C., García, A., Pérez de la Cruz, A., et al. (2010). Psychological characteristics of morbidly obese candidates for bariatric surgery. *Obesity Surgery*, 20: 161–167.

Alberts, HJEM., Mulkens, S., Smeets, M., & Thewissen, R. (2010). Coping with food cravings. Investigating the potential of a mindfulness-based intervention. *Appetite*, 55: 160-163.

Anglé, S., Engblom, J., Eriksson, T., Kautiainen, S., Saha, MT., Lindfors, P., et al. (2009). Three factor eating questionnaire-R18 as a measure of cognitive restraint, uncontrolled eating and emotional eating in a sample of young Finnish females. *International Journal of Behavioral Nutrition and Physical Activity*, 6(41): doi:10.1186/1479-5868-6-41.

Antony, MM., Bieling, PJ., Cox, BJ., Enns, MW. & Swinson, RP. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment* 10(2): 176-81.

Barnes, RD. & Tantleff-Dunn, S. (2010). Food for thought: Examining the relationship between food thought suppression and weight related outcomes. *Eating Behaviors*, 11: 175-179.

Batra, P., Krupa Das, S., Salinardi, T., Robinson, L., Saltzman, E., Scott, T., Pittas, AG., & Roberts, SB., (2013). Relationship of cravings with weight loss and hunger. Results from a 6 month worksite weight loss intervention. *Appetite*, 69: 1-7.

Blundell, J., De Graaf, C., Hulshof, T., Jebb, S., Livingstone, B., Lluich, A., Mela, D., Salah, S., Schuring, E., Van Der Knaap, H. and Westerterp, M. (2010). Appetite control: methodological aspects of the evaluation of foods. *Obesity Reviews*, 11: 251–270.

Cepeda-Benito, A., Gleaves, DH., Williams, TL., Erath, SA. (2000). The development and validation of the state and trait food-cravings questionnaires. *Behavior Therapy*, 31 (1): 151-173,

Coelho, JS., Polivy, J. & Herman, CP. (2006). Selective carbohydrate or protein restriction: Effects on subsequent food intake and cravings. *Appetite*, 47: 352-360.

Crawford, JR., Henry, JD. (2003). The Depression Anxiety Stress Scales (DASS): normative data and latent structure in a large non-clinical sample. *British Journal of Clinical Psychology* 42: 111-131.

Curioni, CC. & Lourenço, PM. (2005). Long term weight loss after diet and exercise: A systematic review. *International Journal of Obesity*, 29: 1168-1174.

DiLorenzo, TM., Walitzer, KS., Sher, KJ., Farha, J. (1991). The effects of smoking cessation on food craving. *Journal of Substance Abuse*, 3 (1): 117-122.

Dixon, JB., Dixon, ME. & O'Brien, PE. (2003). Depression in association with severe obesity: Changes with weight loss. *Archives of Internal Medicine*, 163: 2058-2065.

Erskine, JAK. & Georgiou, GJ. (2010). Effects of thought suppression on eating behaviour in restrained and non-restrained eaters. *Appetite*, 54: 499-503.

Fishbach, A. Friedman, RS. & Kruglanski, AW. (2003). Leading us not unto temptation: momentary allurements elicit overriding goal activation. *Journal of Personality and Social Psychology*, 84(2): 296-309.

Flanagan, SA. (1996). Obesity: The last bastion of prejudice. *Obesity Surgery*, 6: 430-437.

Gendall, KA., Joyce, PR., Sullivan, PF. (1997). Impact of definition on prevalence of food cravings in a random sample of young women. *Appetite*, 28, 63-72.

Gendall, KA., Joyce, PR., Sullivan, PF., Bulik, CM. (1998). Food cravers: characteristics of those who binge. *International Journal of Eating Disorders* 23(4):353-60.

Gilhooly, CH., Das, SK., Golden, JK., et al. (2007). Food cravings and energy regulation: the characteristics of craved foods and their relationship with eating behaviors and weight change during 6 months of dietary energy restriction. *International Journal of Obesity* 31, 1849–1858.

Greenway, FL., Fujioka, K., Plodkowski, RA. (2010). Effect of naltrexone plus bupropion on weight loss in overweight and obese adults (COR-I): a multicentre, randomised, double-blind, placebo-controlled, phase 3 trial. *Lancet* 23: 595-605.

Halmi, KA. & Sunday, SR. (1991). Temporal patterns of hunger and fullness ratings and related cognitions in anorexia and bulimia. *Appetite*, 16(3), 219-237.

Harvey J., Wing, RR. & Mullen, M (1993). Effects on food cravings of a very low calorie diet or a balanced, low calorie diet. *Appetite*, 21(2): 105–115.

Hetherington, MM. & Rolls, BJ. (2001). Dysfunctional eating in the eating disorders. *Psychiatric Clinics of North America*, 24(2):235-48.

Henry, JD & Crawford JR. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Convergent validity and normative data in a large non clinical sample. *British Journal of Clinical Psychology* 44: 227-239.

Herman, CP. & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality*, 43(4): 647-660.

Hill, A. (2004). Does dieting make you fat? *British Journal of Nutrition*, 92(S1), S15-S18.

Hill, A. (2007). The psychology of food craving. *Proceedings of the Nutrition Society*, 66: 277-285.

Hill, AJ., Weaver, CFL. & Blundell, JE. (1991). Craving, dietary restraint and mood. *Appetite*, 17: 187-197.

Hooper, N., Sandoz, EK., Ashton, J., Clarke, A., McHugh, L.(2012). Comparing thought suppression and acceptance as coping techniques for food cravings. *Eating Behaviour*, 13 (1): 62-64.

Jain, AK., Kaplan, RA., Gadde, KM., Wadden, TA., Allison, DB., Brewer, ER., Leadbetter, RA., Richard, N., Haight, B., Jamerson, BD., Buaron, KS. & Metz, A. (2002). Bupropion SR vs. placebo for weight loss in obese patients with depressive symptoms. *Obesity Research*, 10: 1049–1056.

Jebb, SA., Ahern, AL., Olson, AD., et al. (2011). Primary care referral to a commercial provider for weight loss treatment versus standard care: a randomised controlled trial. *Lancet* 378(9801):1485-92.

Johnson, F., Pratt, M., Wardle, J. (2012). Dietary restraint and self-regulation in eating behavior. *International Journal of Obesity* 36(5):665-74.

Karlsson, J., Perrson, LO., Sjöström, L. & Sullivan, M. (2000). Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in

obese men and women. Results from the Swedish Obese Subjects (SOS) study. *International Journal of Obesity*, 24: 1715-1725.

Keys, A., Brozek, J., Henschel, A., Mickelsen, O. & Taylor, H. L. (1950). *The Biology of Human Starvation*, Vols. I–II. University of Minnesota Press, Minneapolis, MN.

Lappalainen, R., Sjoden, PO., Hursti, T., & Vesa, V. (1990). Hunger/craving responses and reactivity to food stimuli during fasting and dieting. *International Journal of Obesity*, 14: 679-688.

Lemmens, VEPP., Oenema, A., Klepp, KI., Henricksen, HB. & Brug, J. (2008). A systematic review of the evidence regarding efficacy of obesity prevention interventions among adults. *Obesity Reviews*, 9: 446-455.

Lovibond SH & Lovibond PF, (1995). *Manual for the Depression, Anxiety Stress Scales*. Sydney: Psychology Foundation.

Lowe, MR. (1993). The effects of dieting on eating behaviour. A three factor model. *Psychological Bulletin*, 114: 100-121

Lowe, MR. (2009). Commentary on: “Neurobehavioral Inhibition of Reward-driven Feeding: Implications for Dieting and Obesity”. *Obesity*, 17: 622-624.

Lowe, MR. & Butryn, ML. (2007). Hedonic hunger: a new dimension of appetite? *Physiology & Behaviour*, 91: 432-439.

Lowe, MR, Doshi, SD., Katterman, SN & Feig, EH. (2013). Dieting and restrained eating as prospective predictors of weight gain. *Frontiers in Psychology*, 4: 577

Lowe, MR. & Levine, AS. (2005). Eating motives and the controversy over dieting: eating less than needed versus less than wanted. *Obesity Research*, 13: 797-806.

Martin, CK., O’Neil, PM., & Pawlow, L. (2006). Changes in food cravings during low calorie and very-low-calorie diets. *Obesity*, 14: 115–121.

Martin, CK., Rosenbaum, D., Han, H., Geiselman, P., Wyatt, H., Hill, J. et al. (2011). Changes in food cravings, food preferences and appetite during a low-carbohydrate and low-fat diet. *Obesity*, 19(10): 1963-1970.

Massey, A. & Hill, AJ. (2012). Dieting and food craving: a descriptive, quasi-prospective study. *Appetite*, 58: 781-785.

Meadows, A. (2012). A systematic review of the effects of dieting on food cravings in an overweight or obese population. (Unpublished master's thesis). University of Chester, United Kingdom.

Mertens, I. L. and van Gaal, L. F. (2000), Overweight, Obesity, and Blood Pressure: The Effects of Modest Weight Reduction. *Obesity Research*, 8: 270–278.

Meule, A., Papiés, EK. & Kübler, A. (2012). Differentiating between successful and unsuccessful dieters: Validity and reliability of the Perceived Self-Regulatory Success in Dieting Scale. *Appetite*, 58: 822-826.

Meule, A., Westenhöfer, J. & Kübler, A. (2011). Food cravings mediate the relationship between rigid, but not flexible control of eating behavior and dieting success. *Appetite*, 57: 582-584.

Moreno, S., Warren, CS., Rodriguez, S., Fernandez, MC., Cepida-Benito, A. (2009). Food cravings discriminate between anorexia and bulimia nervosa: Implications for “success” versus “failure” in dietary restriction. *Appetite*, 52: 588-594.

Morgan, E. and Dent, M. (2010). The economic burden of obesity. Oxford: National Obesity Observatory, 2010.

Morrison, DS., Boyle, S., Morrison, C., Allardice, G., Greenlaw, N. & Forde, L. (2012). Evaluation of the first phase of a specialist weight management programme in the UK National Health Service: prospective cohort study. *Public Health Nutrition*, 15(1): 28-38.

National Obesity Observatory. NOO data factsheet: Adult weight. Accessed 06 July 2012 from http://www.noo.org.uk/NOO_pub/Key_data.

National Institute for Health and Clinical Excellence (2006). Obesity: Guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children. CG43. London: National Institute for Health and Clinical Excellence.

Renehan. AG., Tyson. M., Egger, M., Heller, RF., Zwahlen, M. (2008). Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. *Lancet* 371: 569-578.

Pallister, C. and Lavin, J. (2010). Working together to manage a programme of weight loss. *Primary Health Care*, 20(10): 28-32.

Panel, N. O. E. I. E. (1998). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report. *Obesity Research*, 6(s2), 51S-209S.

Pelchat, ML. (1997). Food cravings in young and elderly adults. *Appetite*, 28: 103-13.

Pelchat, ML. (2002). Of human bondage: Food craving, obsession, compulsion, and addiction. *Physiology & Behavior*, 76(3): 347-352.

Pelchat, M. L., & Schaefer, S. (2000). Dietary monotony and food cravings in young and elderly adults. *Physiology & Behavior*, 68: 353–359.

Polivy, J. (1996). Psychological consequences of food restriction. *Journal of the American Dietetic Association*, 96: 589-592.

Polivy, J., Coleman, J. & Herman, CP. (2005). The effect of deprivation on food cravings and eating behaviour in restrained and unrestrained eaters. *International Journal of Eating Disorders*, 38: 301-309.

Polivy, J. & Herman, CP. (1976). Effects of alcohol on eating behaviour: Influence of mood and perceived intoxication. *Journal of Abnormal Psychology*, 85: 601-606.

Polivy, J. & Herman, CP. (1985). Dieting and bingeing: A causal analysis. *American Psychologist*, 40(2): 193-201.

Rogers, PJ & Smit, HJ. (2000). Food craving and food “addiction”: a critical review of the evidence from a biopsychosocial perspective. *Pharmacology, Biochemistry & Behavior*, 66(1): 3-14.

Stubbs, RJ., Brogelli, DJ., Pallister, CJ., Whybrow, S., Avery, AJ. & Lavin, JH. (2012). Attendance and weight outcomes in 4754 adults referred over 6 months to a primary care/commercial weight management partnership scheme. *Clinical Obesity*, 2: 6-14.

Stunkard, AJ & Messick, S. (1985). The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of Psychosomatic Research* 29: 71-83.

Teixeira, PJ., Going, SB., Houtkooper, LB., Cussler, EC., Metcalfe, LL., Blew, RM., et al. (2004). Pretreatment predictors of attrition and successful weight management in women. *International Journal of Obesity*, 28: 1124-1133.

Teixeira, P.J., Going, S.B., Sardinha, L.B. & Lohman, T.J. (2005). A review of psychosocial pre-treatment predictors of weight control. *Obesity Reviews*, 6: 43-65.

Timko, C.A., Perone, J., & Crossfield, A. (2006). Are you currently on a diet? What respondents mean when they say “yes”. *Eating Disorders. The Journal of Treatment & Prevention*, 14: 157-166.

Truby, H., Baic, S., deLooy, A., Fox, K.R., Livingstone, MBE., Logan, C.M., et al. (2006). Randomised controlled trial of four commercial weight loss programmes in the UK: Initial findings from the BBC “diet trials”. *British Medical Journal*, 226: 1309-1314.

Wadden TA, Foreyt JP, Foster GD, (2011). Weight loss with naltrexone SR/bupropion SR combination therapy as an adjunct to behavior modification: the COR-BMOD trial. *Obesity* 19(1): 110-120.

Wadden, T.A., Stunkard, A.J., Day, S.C., Gould, R.A., & Rubin, C.J. (1987). Less food, less hunger: Reports of appetite and symptoms in a controlled study of protein-sparing modified fast. *International Journal of Clinical Psychology*, 27: 239-249.

Waters, A., Hill, A. & Waller, G. (2001). Bulimics' responses to food cravings: Is binge eating a product of hunger or emotional state? *Behaviour Research & Therapy*, 39: 877-886.

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review*, 101, 34-52.

Weingarten, HP. & Elston, D. (1990). The phenomenology of food cravings. *Appetite*, 15 (3): 231-246.

Weingarten, HP. & Elston, D. (1991). Food cravings in a college population, *Appetite*, 17 (3): 167-175.

White, MA., Whisenhunt, BL., Williamson, DA., Greenway, FL. & Netemeyer, RG. (2002). Development and validation of the Food-Craving Inventory. *Obesity Research*, 10: 107-114.

Wilcox, CS., Oskooilar, N., Erickson, JS., Billes, SK., Katz, BB., Tollefson, G., Dunayevich, E. (2010). An open-label study of naltrexone and bupropion combination therapy for smoking cessation in overweight and obese subjects, *Addictive Behaviors*, 35(3): 229-234.

Withrow, D. & Alter DA., (2011). The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. *Obesity Review*, 12: 131-141.

Witt, AA., Katterman, SN. & Lowe, MR. (2013). Assessing the three types of dieting in the Three-Factor model of dieting. The Dieting and Weight History Questionnaire. *Appetite*, 63: 24-30.

Wurtman, RJ. and Wurtman, JJ. (1995). Brain serotonin, carbohydrate-craving, obesity and depression. *Obesity Research*, 3: 477S–480S.

APPENDICES

Appendix 1: Search Strategy

A full electronic search of the following databases was conducted using Ovid Online: AMED, Embase, Global Health, Ovid MEDLINE, PsycARTICLES and psycINFO. Searches were extended to include literature from the early 20th Century, in order to retrieve articles that might reflect a change in the definition and construct of ‘food craving’ across time. The search was conducted using all relevant terms relating to i) weight management – ie. Dieting, obesity, and ii) craving. These terms were combined in order to only return papers that were reporting on both factors within the article. Search syntax is provided below.

Retrieved April 14th, 2014

Database: AMED (Allied and Complementary Medicine) <1985 to April 2014>, Embase Classic+Embase <1947 to 2014 April 11>, Global Health <1973 to 2014 Week 14>, Global Health Archive <1910 to 1972>, Ovid MEDLINE(R) <1946 to April Week 1 2014>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <April 11, 2014>, PsycARTICLES Full Text, PsycINFO <1806 to April Week 2 2014>

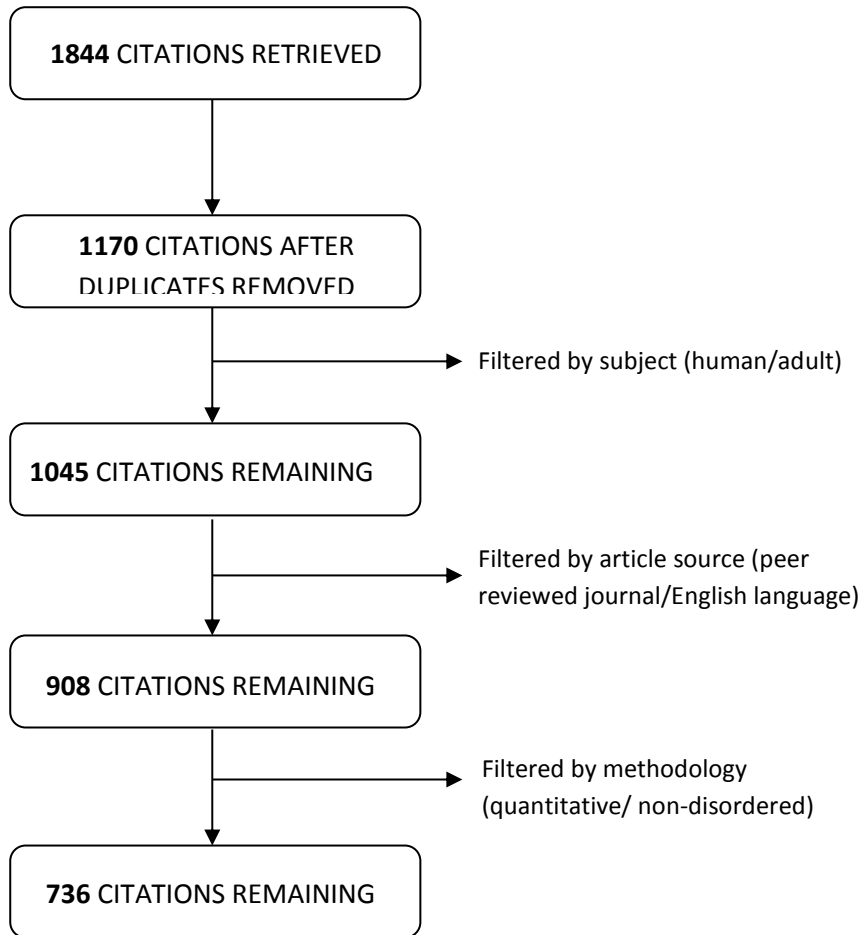
Search Strategy:

1 (food adj crav*).mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (1301)

- 2 craving.mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (18558)
- 3 obesity.mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (602119)
- 4 (weight adj loss).mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (171027)
- 5 diet*.mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (1596206)
- 6 (diet* adj behavio*).mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (13725)
- 7 (weight adj manag*).mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (9796)
- 8 (diet* adj2 crav*).mp. [mp=ab, hw, ti, sh, tn, ot, dm, mf, dv, kw, bt, nm, kf, px, rx, an, ui, tx, ct, tc, id, tm] (133)
- 9 1 or 2 (18972)
- 10 3 or 4 or 5 or 6 or 7 or 8 (2138151)
- 11 9 and 10 (1844)

Following retrieval of the papers, duplicates were removed and filtered according to the following criteria i) measuring craving in human subjects, ii) measuring craving in adults iii) published in a peer reviewed journal iv) written in English v) used quantitative methodology and vi) measuring cravings in a non-disordered population.

Abstracts were read to determine the relevance of each article to the research question. An illustration of this procedure is provided below.



The titles and abstracts of the 736 citations remaining were reviewed and considered in relation to the research aims of the current study and the relevance of the citation to current literature on i) food cravings, ii) dieting and/or weight loss and iii) obese and overweight populations.

Appendix 2: Notification of Ethical Approval

Faculty of Medicine and Health
Research Office

University of Leeds
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Clarendon Way
Leeds LS2 9NL
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☎ +44 (0) 113 343
11 March 2013

Miss Emilie F Smithson
Psychologist in Clinical Training
Clinical Psychology, LIHS
Charles Thackrah Building,
101 Clarendon Road,
University of Leeds, LS2 9LJ



UNIVERSITY OF LEEDS

Dear Emilie

Re ref no: HSLTLM/12/032

Title: Food cravings in people engaged in weight management

I am pleased to inform you that the above research application has been reviewed by the Leeds Institute of Health Sciences and Leeds Institute of Genetics, Health and Therapeutics and Leeds Institute of Molecular Medicine (LIHS/LIGHT/LIMM) joint ethics committee and I can confirm a favourable ethical opinion based on the documentation received at date of this letter.

Document	Version	Date
Ethics Form	1	24.01.13
Information Sheet	1	24.01.13
Consent Form	1	24.01.13
Amendment HSLTLM 12032	1	31.01.13
Response to Reviewer Comments	1	20.02.13
Screen Information Sheet	1	20.02.13
Screen Consent Form	1	20.02.13
Consent Form	2	05.03.13
Response to amendments	1	05.03.13
Screen Consent Form	2	05.03.13

Please notify the committee if you intend to make any amendments to the original research as submitted at date of this approval. This includes recruitment methodology and all changes must be ethically approved prior to implementation. Please contact the Faculty Research Ethics Administrator for further information FMHUniEthics@leeds.ac.uk

Ethical approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.

I wish you every success with the project.

Yours sincerely

Professor Darren Shickle, Acting Chair, LIHS/LIGHT/LIMM Joint REC, University of Leeds

Appendix 3: Information and Consent Page

Screen shots taken from the Bristol Online Survey (BOS)

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Food Cravings in People Engaged in Weight Management

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Information about the Research

You are invited to take part in a research study looking at food cravings in people engaged in active weight management.

This short survey is open to anyone over the age of 18 who is a member of Slimming World. The survey asks you to respond to questions about your eating behaviour and mood. Please ensure that you are in a space in which you feel comfortable before continuing to complete the survey.

This study is in two parts, **Part One** is to be completed now and will take approximately ten minutes. In several weeks time you will receive an email to complete **Part Two** which will ask you to provide a second snapshot of your food cravings and eating behaviour.

If you consent to take part in this study, information about your weight will be accessed from Slimming World using your membership unique identifier. No personal information will be accessed by the researcher in the conduct of this study.

All responses will be anonymous, kept strictly confidential and stored securely. The individual data will only be seen by members of the research team. The results will be grouped together when reporting findings.

You can withdraw from the research at any time, without giving a reason.

If you become concerned about your health when completing this survey, please contact your GP for support.

If you have any questions or comments, please contact me using the details below.

Thank you for your time.

Please note that once you have clicked on the CONTINUE button at the bottom of each page you cannot return to review or amend that page.

Emilie Smithson
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Consent

I understand that my participation is voluntary and that I am free to withdraw from the survey at any time during completion without giving a reason, by providing my Slimming World membership number to the researcher.

I understand that if I require further information about the research project or the survey, I can contact the researcher via e-mail on umefs@leeds.ac.uk or at the address provided at the end of the survey.

I have read and understood the information provided on the previous page and by submitting this survey I agree to take part in the research project.

I understand that all responses are anonymous and will be kept confidential.

I understand that in providing my membership number I agree for information about my height and weight to be provided to the researcher.

By clicking on 'Continue' I agree to take part in the research project.

Continue >

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Appendix 4: Measures

BOS screen shots and full questionnaires


a) Demographic Information

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Background Information

Please provide the following information

- Please enter your full 8-digit member's card number exactly as written under your name on the front of your card (circled red on image below). Please remove any spaces or dashes from your response to give a numeric string e.g. 01234567



- Please enter your date of birth
(DD-MM-YYYY)

- Are you
 - male
 - female
 If female: are you currently pregnant?
 - yes
 - no

- Please select your height in feet and inches
Select an answer

If you selected Other, please specify:

- Please indicate any health condition for which you are currently taking medication.
(select all that apply)

- Diabetes Type 1
- Diabetes Type 2
- Hypertension (High Blood Pressure)
- Angina
- Cholesterol

b) Control of Eating Questionnaire (7 day version)

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Food Cravings in People Engaged in Weight Management

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Survey Questions - Part One

The following questions ask you to think about your eating and craving experiences over the past seven days

6. Please read the questions carefully and select a response that best represents how you felt over the past seven days

	Please select a response using this scale										
	0	1	2	3	4	5	6	7	8	9	10
a. How hungry have you felt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. How full have you felt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. How strong was your desire to eat sweet foods?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. How strong was your desire to eat savoury foods? (french fries, crisps, burgers, pizza etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. How happy have you felt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. How anxious have you felt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. How alert have you felt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. How contented have you felt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A food craving is a strong urge to eat a particular food or drink

7. Please read the questions carefully and select a response that best represents how you felt over the past seven days

Please read each question carefully and choose a number on the scale that best represents your experience, from 0=not at all to 10=extremely. Answer all questions according to your experience **over the past 7 days**

1. How hungry have you felt?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
hungry hungry

2. How full have you felt?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
full full

3. How strong was your desire to eat sweet foods?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
strong strong

4. How strong was your desire to eat savoury foods? (french fries, crisps, burgers, pizza etc)?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
strong strong

5. How happy have you felt?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
happy happy

6. How anxious have you felt?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
anxious anxious

7. How alert have you felt?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
alert alert

8. How contented have you felt?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
contented contented

A food craving is a strong urge to eat a particular food or drink

9. During the last 7 days how often have you had food cravings?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Very
often

10. How strong have any food cravings been?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
strong strong

11. How difficult has it been to resist any food cravings?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
difficult difficult

12. How often have you eaten in response to food cravings?

Not at all 0 1 2 3 4 5 6 7 8 9 10 After
every one

How often have you had food cravings for the following types of food/drink?

13. Chocolate or chocolate flavoured foods

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
often

14. Other sweet foods (cakes, pastries, biscuits, etc)

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
often

15. Fruit or fruit juice

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
often

16. Dairy foods (cheese, yoghurts, milk, etc)

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
often

17. Starchy foods (bread, rice, pasta, etc)

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
often

18. Savoury foods (french fries, crisps, burgers, pizza etc)?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
often

19. Generally, how difficult has it been to control your eating?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
difficult difficult

20. Which **one food** makes it most difficult for you to control eating?

.....

21. How difficult has it been to resist eating this food during the last 7 days?

Not at all 0 1 2 3 4 5 6 7 8 9 10 Extremely
difficult difficult

c) Three Factor Eating Questionnaire (Restraint sub-scale)

The following questions ask about food related behaviours. Please choose the item that best describes your own behaviour over the past seven days

12.

	When I think of the past seven days, this statement is:			
	DEFINITELY TRUE	MOSTLY TRUE	MOSTLY FALSE	DEFINITELY FALSE
a. I have been deliberately taking small helpings as a means of controlling my weight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. I have been consciously holding back at meals in order to lose weight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. I have not eaten some foods because they make me fat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. I have frequently avoided 'stocking up' on tempting foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. I have consciously eaten less than I wanted to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. Using the descriptions below, indicate your level of restraint over the past seven days

	NO RESTRAINT ----- TOTAL RESTRAINT							
	1	2	3	4	5	6	7	8
a. 1= NO RESTRAINT (eat whatever I want, whenever I wanted it) 8= TOTAL RESTRAINT (constantly limited food intake, never 'gave in')	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14.

	select the response that best describes you		
	NOT DIETING	WATCHING WHAT I EAT (so I don't gain weight)	DIETING TO LOSE WEIGHT
a. Over the past seven days I would describe my eating behaviour as	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask about food-related behaviours. Please choose the item that best describes your own behaviour **over the past seven days**.

I have been deliberately taking small helpings as a means of controlling my weight	DEFINITELY TRUE	MOSTLY TRUE	MOSTLY FALSE	DEFINITELY FALSE
I have consciously held back at meals in order to lose weight	DEFINITELY TRUE	MOSTLY TRUE	MOSTLY FALSE	DEFINITELY FALSE
I have not eaten some foods because they make me fat	DEFINITELY TRUE	MOSTLY TRUE	MOSTLY FALSE	DEFINITELY FALSE
I have frequently avoided 'stocking up' on tempting foods	DEFINITELY TRUE	MOSTLY TRUE	MOSTLY FALSE	DEFINITELY FALSE
I have consciously eaten less than I wanted to	DEFINITELY TRUE	MOSTLY TRUE	MOSTLY FALSE	DEFINITELY FALSE

	NO RESTRAINT				TOTAL RESTRAINT			
Using the scale to the right, what number between 1-8 would you give yourself?								
1= NO RESTRAINT (eat whatever I want, whenever I want it) 8= TOTAL RESTRAINT (constantly limit food intake, never 'giving in')	1	2	3	4	5	6	7	8

d) Perceived Self-Regulatory Control of Dieting

The following questions ask about your dieting success over the past seven days

15.

	Please select a response using this scale						
	1	2	3	4	5	6	7
a. How successful have you been in watching your weight ?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. How successful have you been in losing extra weight ?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. How difficult have you found it to stick to your diet plan ?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. How difficult have you found it to stay in shape ?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. Over the **past seven days**, what was your diet 'goal' (weight loss target). If you aimed to maintain your weight, please enter 'maintain'

[Continue >](#)

Survey testing only
[Check Answers & Continue >](#)

Please answer the following questions about dieting success based on your experiences **over the past seven days**. Indicate your responses by selecting the appropriate number on the scale.

ITEM	RESPONSE						
	1	2	3	4	5	6	7
How successful have you been in watching your weight?	1	2	3	4	5	6	7
How successful have you been in losing extra weight?	1	2	3	4	5	6	7
How difficult have you found it to stick to your diet plan?	1	2	3	4	5	6	7
How difficult have you found it to stay in shape?	1	2	3	4	5	6	7

e) *The Depression Anxiety and Stress Scale*

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The following statements ask you about your mood over the past seven days. There are no right or wrong answers, try not to spend too long on any one response.

16. Please read each statement and indicate how much this has applied to you over the past seven days

	How much did this statement apply to you?			
	NOT AT ALL	SOME OF THE TIME	A GOOD PART OF THE TIME	MOST OF THE TIME
a. I found it hard to wind down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. I was aware of dryness of my mouth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. I couldn't seem to experience any positive feeling at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. I experienced breathing difficulty (eg excessively rapid breathing/breathlessness in the absence of physical exertion)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. I found it difficult to work up the initiative to do things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. I tended to over-react to situations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. I experienced trembling (eg in the hands)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. I felt that I was using a lot of nervous energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i. I was worried about situations in which I might panic and make a fool of myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
j. I felt that I had nothing to look forward to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
k. I found myself getting agitated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
l. I found it difficult to relax	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
m. I felt down-hearted and blue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
n. I was intolerant of anything that kept me from getting on with what I was	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please read each statement and indicate a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

- 0 Did not apply to me at all
- 1 Applied to me to some degree, or some of the time
- 2 Applied to me to a considerable degree, or a good part of time
- 3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3

11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

Appendix 5: Health conditions currently prescribed medication (Baseline)

Condition	Frequency
<i>Angina</i>	12
<i>Anxiety</i>	29
<i>Arthritis</i>	53
<i>Asthma</i>	127
<i>Cancer</i>	11
<i>Cholesterol</i>	183
<i>Chronic Pain</i>	191
<i>Depression</i>	87
<i>Diabetes</i>	84
<i>Heart Condition (not specified)</i>	15
<i>Hypertension</i>	309
<i>Hypothyroidism</i>	170
<i>Migraine</i>	24
<i>Mood (not specified)</i>	273

Appendix 6: Epistemological Reflection

In the physical sciences, the researcher aims to seek a universal truth about the world around us through a process of deductive reasoning and underpinned by deterministic philosophy. Scientists seeking to predict and control a *physical* reality based their approaches on empiricism; testing theories through direct manipulation and observation. In the context of human free will and action, philosophers argue against determinism, and suggest instead that an individual will always have more than one option available to them in any circumstance, and that the reasoning for selecting a given action has a unique weighting in the mind of the individual. Therefore, such theorists would argue that human nature can not be explained by the same deductive reasoning that underpins physical science.

Whilst the two tenets may at first seem disharmonious, this might not strictly speaking be true. In order to function in, learn from, and adapt to their environment, people will also develop heuristics which allow them to predict and control the world around them, and quite often, will behave and interact with the world in a predictable fashion. As a scientist practitioner, I believe that there are ways in which we can learn from and understand certain human behaviours and thereafter apply that learning to clinical practice. However, I remain cautious about the degree to which human *cognition* can be measured accurately. Critical realism would postulate that all measurement is fallible, and all theory is revisable, and therefore the importance of multiple measurement and repeated observation is one way in which individual error can be minimized.

In undertaking the current research, it was clear from the outset that one of the major sources of confusion or *error* in the research into food cravings and dieting was the inconsistent way in which the phenomenon has been defined and measured. Whilst I maintain that the experience of ‘food craving’ may or may not be a post hoc attribution for a desire to eat a ‘forbidden’ food, or a way of explaining a perceived momentary ‘lapse’ in behaviour, I still believe that a common language should be used by researchers if the unhelpful narrative linking dieting and food cravings is to be challenged. In the first instance, this means providing people with a clear definition of what is meant by food ‘craving’, and measuring the occurrence of such phenomena in a sample of people engaged in weight regulation. Whilst the current study did not attempt to explore the *choices* and *reasoning* of those that did eat in response to a ‘craving’, it did challenge the assumption that attempts to regulate one’s weight are inherently hampered by unwanted ‘cravings’ for food.