

Self-management of weight in adults with
overweight and obesity: characterising and
evaluating cognitive and behavioural strategies

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Abstract

Background: The majority of adults in the UK are overweight or obese, and many embark on weight loss attempts, often without professional support. This dissertation set out to hone in on the cognitive and behavioural strategies used by adults with overweight and obesity attempting to lose weight, particularly in self-guided attempts, and to test the relationship between use of these strategies and weight loss success.

Methods: A new taxonomy and questionnaire were developed to provide a framework to identify the cognitive and behavioural strategies used by individuals during weight loss attempts. The taxonomy was used in a systematic review and meta-analysis of self-help interventions for weight loss and in a systematic review of qualitative studies of self-directed weight loss. The questionnaire was used in an observational cohort study in adults with overweight and obesity trying to lose weight.

Results: The taxonomy and questionnaire consist of 117 strategies. The qualitative review illuminated a range of attitudes and beliefs towards these strategies and highlighted the centrality of interpretation of self-monitored data. The quantitative review found that self-help interventions led to greater weight loss than unsupported attempts to lose weight at six months. In the cohort study, despite heterogeneity in the strategies employed, coherent patterns of behaviours emerged for individual participants. Strategies related to motivational support, dietary impulse control, and weight loss planning and monitoring were associated with greater weight loss.

Conclusion: This dissertation demonstrates that self-help interventions can lead to significant weight loss and provides results to guide the content of such interventions. It maps out a previously uncharted area and provides a set of tools for further research and intervention development.

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Jamie Hartmann-Boyce, 2016

Statement of contribution

The studies, analyses, and interpretation of the results are all the original work of the author, completed under the supervision of Professor Paul Aveyard and Professor Susan Jebb, both at the Nuffield Department of Primary Care Health Sciences, University of Oxford.

As the author, I led all aspects of the thesis, including design, conduct, and analyses of the studies presented in the subsequent chapters, as well as writing the included chapters and resulting journal articles.

All tables and figures contained within this thesis are my own creation.

I hereby declare that no part of this thesis has been submitted for any other degree at this or any other university.

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Frequently used abbreviations

BCT	behaviour change technique
BMI	body mass index
BOCF	baseline observation carried forward
CASP	Critical Appraisal Skills Programme
CI	confidence interval
DALY	disability-adjusted life year
HbA1C	glycated haemoglobin, measure of long term blood glucose levels
IQR	interquartile range
OR	odds ratio
OxFAB	Oxford Food and Activity Behaviours
SD	standard deviation
SE	standard error
WHO	World Health Organization

Chapter 1 Introduction

1.1 Chapter summary

The objective of this dissertation is to hone in on the cognitive and behavioural strategies used by adults with overweight and obesity to lose weight and maintain that weight loss, particularly in self-guided weight loss attempts, and to test the relationship between use of these strategies and weight loss success. This chapter presents the context and rationale behind this objective, outlining how existing evidence has informed the shape of this dissertation. First, it discusses obesity in adults, defining the scope and nature of the problem. It then goes on to discuss intentional weight loss in this population, including the benefits of weight loss, the epidemiology of weight loss attempts, and current approaches to weight management in the UK. Framed against this background and existing research, the potential role of self-management is outlined, followed by a brief description of what we know to date about behaviour change strategies as they relate to weight loss. The chapter concludes by restating the aims and objectives as they relate to the context outlined and by providing a brief introduction to the subsequent chapters.

1.2 Obesity in adults

1.2.1 Prevalence

According to the latest estimates from the World Health Organization (WHO), in 2014, more than 1.9 billion adults (18+) were overweight, of whom 600 million were obese, representing 39% and 13% of the world's adult population, respectively.⁽¹⁾ Worldwide, obesity has more than doubled since 1980, and is projected to increase still; if current rates continue, almost half of the world's population is projected to be overweight or

obese by 2030.(2) This is already the case in the UK and Ireland, where data from 2014 showed that 61.7% of adults were overweight or obese, 25.6% of whom were obese.(3) A large systematic review of global, regional and national prevalence of overweight and obesity spanning the period from 1980 to 2013 ranked the UK eighth out of the 34 OECD countries for prevalence of adult overweight and obesity, with a rate of increase higher than that in the US over the same period.(4-7) This increase is mostly down to a rise in obesity, rather than overweight; the prevalence of overweight has remained broadly stable in the UK over the past 20 years (36-39%), but the prevalence of obesity among adults has risen from 14.9% in 1993 to 25.6% in 2014. This rate of increase has slowed since 2001 onwards, but the trend is still upwards.(3) Despite recent government emphasis on childhood obesity, obesity is far more prevalent in UK adults than in children. This is predicted to continue, affecting 60% of women, 50% of men, and 25% of children in the UK by 2050, with worrying implications for both health and economic outcomes (see 1.2.4 Societal costs).(8)

Box 1. Definition and measurement of obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. There are a number of ways to measure and define overweight and obesity, which are described briefly below.

Body Mass Index (BMI) is the most commonly used index for defining weight status, and is used throughout this dissertation. It is a simple index dividing a person's weight in kilograms (kg) by the square of their height in metres (m²). The WHO defines overweight as a BMI ≥ 25 kg/m² and obesity as a BMI ≥ 30 kg/m².(1) BMI values in the obese range can also be further divided into stages, with a BMI of 35 to 39.9 kg/m² defined as 'Obesity II' or 'severe obesity' and a BMI of over 40 kg/m² defined as

‘Obesity III’ or ‘morbid obesity’. ‘Morbid obesity’ is also used to describe individuals with a BMI of 35 to 39.9 kg/m² if they are experiencing an obesity-related health condition. Some organizations use a lower BMI cut-off point for defining overweight and obesity in Asian populations due to increased susceptibility to obesity-related illnesses at lower BMI levels than in people of other ethnicities. Typically, this cut-off is BMI ≥ 23 kg/m² for overweight and ≥ 27.5 kg/m² for obesity.(9)

On a population level, BMI is a useful measure of overweight and obesity. However, it is unable to take into account varying levels of fat mass in individuals.(9) **Waist circumference** and **waist to hip ratio** are also commonly used measures when assessing weight status, and may be more accurate in regards to fat mass. However, use of these measures is often prohibited by resource availability, and evidence from systematic reviews suggest BMI, waist circumference and waist to hip ratio all have relatively similar accuracy in predicting the health risks associated with overweight and obesity.(6, 10) **Body composition** tools, which aim to assess the proportion of body constituents, especially fat, are also available, but are not practical in many research contexts. These include measurements of skinfold thickness, bioelectric impedance (measuring impedance of the body to a small electric current), dual energy x-ray absorptiometry (DXA, which measures differential absorption of x-rays), and magnetic resonance imaging (MRI).(11) Recent tools for defining obesity stages have also taken into account obesity-related comorbidity and functional status.(12)

Due to their prevalence in existing literature and practice, the relative ease and feasibility of their use compared to other measures, and their predictive value for obesity-related comorbidities, BMI and weight are used throughout this dissertation.(13)

1.2.2 Causes and determinants

So what lies behind the rise in obesity prevalence? The fundamental cause of obesity is an imbalance between energy expenditure and intake (calories consumed in food and drinks versus calories expended in basal metabolism and physical activity), but it is of course not that simple. Increases in overweight and obesity around the world, even in places where levels were historically low, illustrate the role of the environment in the rise of obesity prevalence, including readily available energy dense food and fewer imperatives for physical activity.(1) These changes directly impact human behaviour, and urbanisation serves as a clear example of this phenomenon. Numerous studies and reviews have highlighted the process by which urbanisation in developing countries has led to stark and rapid increases in obesity prevalence.(14-16) Urbanisation brings about dramatic changes in living environments, contributing to marked increases in the consumption of animal fat and protein, refined grains, and added sugar – a phenomenon referred to as ‘the nutrition transition’.(15) Simultaneously, with urbanisation the need for physical activity is reduced through decreases in active transport and increases in mechanised work where previously livelihoods were made in more manual occupations.(14) Such environmental and societal changes have been occurring worldwide and are outpacing human biology. We evolved in conditions of relative food scarcity, in which high levels of physical activity were required to maintain livelihoods and lives. As a species this leaves us genetically ill-equipped to deal with the environmental changes that have occurred over recent decades.

These determinants affect almost everyone to some extent; however, some groups appear more susceptible than others. Overall, women are marginally more likely than men to be overweight or obese in the UK and Ireland.(3) In England, there is also a

higher prevalence of morbid obesity ($\text{BMI} > 35 \text{ kg/m}^2$) in women than in men (4% vs 2%, respectively).(17) Age is also related to obesity status, with prevalence in England found to increase with age before decreasing in the oldest age groups. In 2014, obesity rates peaked in men at ages 55 to 64 (35%) and in women at ages 64 to 75 (35%). Though trends in obesity in younger age people in England appear to be plateauing, those in middle-aged and older adults continue to rise.(17) In terms of ethnicity, UK data are limited as national surveys have tended to have small numbers of minority populations.(8) However, combined data from three years of the Health Survey for England found variations in mean BMI by ethnic group: among men, white men had the highest mean BMI (27.4 kg/m^2) and Asian men had the lowest (26.0 kg/m^2), whereas among women, black women had the highest mean BMI (29.5 kg/m^2) and white women had the lowest (25.6 kg/m^2).(17)

In middle and high income countries, the socially disadvantaged also appear to be more vulnerable to overweight and obesity.(8, 18-20) In England, the inverse relationship between obesity prevalence and socioeconomic advantage is present regardless of measure used. In women in particular, levels of obesity fall steadily with rising levels of household income and indeed with all measures of deprivation; for men in England, only occupation- and qualification-based measures show differences in obesity rates by levels of deprivation.(21) Reasons for this association are explored further in Chapter 3, but (briefly) they have been theorised to include environmental drivers (e.g. limited access to healthy food and safe and affordable recreation)(22, 23), lower levels of executive functioning (a theorised control network regulating behaviours, which has been linked with poverty in childhood)(24, 25), and a lack of cultural capital which may diminish health-related behaviour change.(26) Despite these associations, trends

from England show the prevalence of obesity increasing in all socio-economic brackets.(21)

As well as differences in population groups, inter-individual differences also play a role in susceptibility to obesity. The systems mapping approach employed in the 2007 UK Government Foresight report on obesity concluded that energy imbalance was caused by a complex and multifaceted system of determinants, in which no single influence dominated, but identified primary appetite control in the brain, the force of dietary habits, physical activity levels, and ambivalence experienced by individuals in making lifestyle changes as key determinants.(27) Psychological factors, including self-efficacy, autonomy, and ability to cope with stress, have also been found to be associated with obesity.(28) In addition, genetics play a role in inter-individual differences in susceptibility. Systematic reviews of genetic and genome wide association studies have identified numerous genetic polymorphisms that appear to predispose to obesity, both at the single gene and genome-wide level.(29) This includes polymorphisms in adipokine genes, and genes involved in hypothalamic pathways.(30, 31) However, the associations between genetic polymorphisms and obesity to date are relatively modest - the most strongly associated gene variant so far (rs9939609) has been estimated to have only a 1% effect on the variance observed in BMI.(29) Inter-individual genetic variations do not make obesity inevitable nor weight loss impossible, but may present additional challenges for individuals who carry these polymorphisms.

1.2.3 Health consequences

The rising prevalence of obesity is an urgent problem because elevated BMI is a major cause of preventable morbidity and mortality worldwide.(32) The latest Global Burden of Disease study estimates that overweight and obesity caused 3.9 million deaths in

2015, with high BMI ranked as the fourth largest contributor to disability adjusted life years (DALYs), estimated to cause over 120 million DALYs in 2015.(33) A 2014 McKinsey report estimated that, globally, 5% of deaths each year are caused by obesity.(34) Here in the UK, the picture is similarly worrying. Estimates from Public Health England state that in 2010 over 6% of deaths were attributed to obesity.(5) Recent estimates from a synthesis of cohort studies suggest that, in Europe, 14% of premature deaths could be prevented if people were of a healthy weight.(35) In the 2015 Global Burden of Disease study, high BMI was the third highest contributor to DALYs in the UK.(33)

These preventable deaths and DALYs arise because BMI above healthy ranges is linearly associated with increased risk factors for a wide range of diseases.(36-39) The link between cardiovascular diseases (including hypertension, coronary heart disease, and stroke) and obesity is well-known – over the next 20 years, it is predicted that rising levels of obesity will lead to 1.63 million new cases of coronary heart disease in the UK.(40) The link between obesity and type 2 diabetes is also well documented - in England, 12.4% of adults with obesity are estimated to have type 2 diabetes, five times the rate of that in people within the healthy BMI range. As of 2013, this equated to just under 2.5 million people estimated to have type 2 diabetes; in line with the rising prevalence of obesity, this number is expected to rise to 4.6 million, almost 10% of the adult population, by 2030.(41) Less well known is the link between obesity and some cancers - around 17,000 cases of cancer a year in the UK are linked with overweight or obesity, which includes two of the most common cancers (bowel and breast), and pancreatic cancer, one of the hardest to treat.(42) Recent estimates suggest that, if current trends continue, obesity will lead to 670,000 new cases of cancer in the UK over

the next 20 years.(40) Obesity is also associated with increased risk of musculoskeletal disorders (especially osteoarthritis and lower back pain), reproductive and urological problems (including stress incontinence, infertility, polycystic ovarian syndrome and erectile dysfunction), respiratory problems (including sleep apnoea and asthma), non-alcoholic fatty liver disease, and mental ill health.(43, 44)

As suggested by their linear relationship, the links between obesity and disease are almost certainly not coincidental – raised BMI causes these conditions through mechanical and metabolic pathways. These links are outlined briefly below, as they provide some insight into the ways in which weight loss can improve health. Most straightforwardly, carrying excess weight can put extra strain on many parts of the body, including the musculoskeletal, cardiovascular, and respiratory systems – our joints, muscles, heart and lungs all have to work harder if we are carrying more weight.(45, 46) Links with heart disease are also relatively straightforward - overweight and obesity can lead to dyslipidaemia which contributes to atherosclerosis; narrow or blocked arteries can cause coronary heart disease, heart attacks, hypertension, angina and stroke, though of course there are also other mechanisms at play. In the case of type 2 diabetes there are a number of contributing factors. Obesity leads to increased production of fatty acids and peptide hormones and increased ectopic fat distribution (deposition of fat in locations in the body which are not typically associated with fat storage), both of which contribute to reduced insulin sensitivity. In addition, mitochondrial dysfunction resulting from obesity may both decrease insulin sensitivity and compromise the function of insulin-producing cells.(47) Links between obesity and cancer are similarly complex, with a number of factors at play. This includes, but is not limited to, mechanisms by which an increase in fat cells leads to an increase in a variety

of hormones and proteins which can contribute to several different types of cancer (e.g. oestrogen contributing to breast cancer), and mechanisms by which fat cells attract immune cells to body tissues which can cause long-lasting inflammation, increasing the risk of cancer in these tissues.(48)

1.2.4 Societal costs

As well as its costs to individuals in terms of preventable morbidity and mortality, obesity also comes with costs to society, including direct healthcare costs and broader economic costs through lost productivity. McKinsey estimates that, globally, obesity has roughly the same economic impact as smoking or armed conflict, at \$2.0 trillion US dollars annually.(34)

Obesity is estimated to cost UK society three percent of its GDP, £6 billion of which are direct costs to the NHS.(34) Recent projections estimate that by 2030 obesity-related ill-health will cost the NHS between £10 and £12 billion per year.(2) The wider costs to society and business are estimated to reach five times that amount.(49) At an individual level, rise in BMI is linearly associated with increased costs to the NHS, with healthy weight individuals costing on average £805 per year, obese class I (BMI > 30 and < 35 kg/m²) 58% higher at £1,274 and obese class III (BMI ≥ 40 kg/m²) costing on average £1,493, 86% higher than a healthy weight individual.(50)

These complications and costs present a powerful incentive for further research and interventions to tackle obesity. In the UK, recent estimates suggest that reducing the prevalence of overweight and obesity by just 1% each year below predicted trends would save £300 million in NHS health and social care costs in the year 2035 alone.(40)

Box 2. Note on ‘the costs of obesity’

Though there is a clear need to establish the societal costs of obesity, as well as to establish indicative costs to the NHS of treating individuals who are overweight or obese, such figures make me slightly wary from a personal perspective. I worry, if in the wrong hands, they could lend themselves to a perspective which points the finger at certain individuals for placing ‘avoidable’ burdens on the NHS, or views the financial burden of obesity as a more powerful moral imperative to action than the knowledge that millions of individuals are suffering with preventable illnesses. I in no way support that view and am not seeking to place blame on any individuals. Rather, the costs provided here serve as one way to illustrate the extent of the problem, and to highlight the potential benefits in investing public resources in effective interventions for combatting obesity.

1.3 Weight loss in adults with overweight or obesity

The research contained in this dissertation relates specifically to adults with overweight or obesity trying to lose weight. As outlined below, many adults with overweight or obesity embark on weight loss attempts, and successful weight loss in this population can lead to significant clinical benefits.

1.3.1 Epidemiology of weight loss attempts

As overweight and obesity rates increase, so too does the number of people trying to lose weight. A recent systematic review and meta-analysis of cross-sectional and prospective cohort studies of the prevalence of personal weight control attempts in adults, including both weight loss and weight maintenance, found that 42% of adults

from general populations reported trying to lose weight, with 23% reporting trying to maintain weight.(51) Recent estimates from England show the population prevalence of weight loss attempts increasing year on year, from 39% in 1997 to 47% in 2013.(52) This is consistent with figures from other Western countries, with rates from 25 to 50% reported amongst American adults.(53-55)

In the systematic review cited above, higher prevalence of weight loss attempts was found in women and in individuals with overweight or obesity.(51) This is consistent with data from England and the US - in the 2013 Health Survey for England, the biggest predictors of weight loss attempts were being in the overweight/obese categories and being female (odds ratio (OR) 3.01, 95% confidence interval (CI) 2.85 to 3.18 compared to men).(52, 55) In 2013, 53% of English adults with overweight ($\text{BMI} \geq 25$ to $< 30 \text{ kg/m}^2$) and 76% of adults with obesity ($\text{BMI} > 30 \text{ kg/m}^2$) were attempting to lose weight, compared to 30% of adults in the healthy range.(52) In this same group, having a health condition that could be improved by weight loss (defined in this study as hypertension or cardiovascular disease) was modestly associated with increased weight loss attempts in adults with overweight (OR 1.24, 95% CI 1.03 to 1.51) and obesity (OR 1.46, 95% CI 1.19 to 1.79), as was being in the middle or higher social classes (OR 1.49, 95% CI 1.38 to 1.61). Ethnicity was not significantly associated with weight loss attempts.(52)

Amongst people trying to lose weight, success is varied. In a large, nationally representative survey in the US, 40% of respondents embarking on weight loss attempts in the past year reported losing at least five percent of their starting weight; of these half lost more than 10%.(56) Unpublished data from a recent representative sample of European adults with overweight and obesity trying to lose weight (UK, Denmark and

Portugal) found that 10% of those trying to lose weight lost at least some weight, but only 2% of those trying to lose weight lost weight *and* did not regain all of the weight they had lost, highlighting the issue of weight regain and the need to focus on weight loss maintenance as well as weight loss.(57)

Despite the large number of people trying to lose weight at any one time, the approaches used to lose weight in the general population are surprisingly under-researched. In the recent systematic review of weight management attempts, 27 of the included studies included some information on how people were attempting to control their weight, though often in very limited detail; the majority reported ‘dieting’ (reducing energy consumption) and doing or increasing physical activity.(51) Only three studies reported whether participants received advice from a healthcare professional – from these the prevalence was 13.2%. Nine assessed use of a weight control programme or group, prevalence here was 6.3%. Of the 14 studies which investigated use of weight loss pills or supplements, prevalence was 10%. This systematic review did not report on use of self-help resources. However, unpublished data from the recent representative sample of European adults with overweight and obesity introduced above found that approximately 15% used self-help resources in their weight loss attempt. Over three-quarters of men and half of women surveyed reported “doing it on their own” – with no external resources.(57)

1.3.2 Benefits

Given the number of people trying to lose weight, one silver lining in this onslaught of worrying statistics is that for people who are overweight or obese, weight loss is highly likely to benefit their health. The evidence that losing weight benefits health is particularly strong in the case of preventing type 2 diabetes, as evidenced by large

diabetes prevention trials.(58, 59) In these trials, intensive lifestyle interventions (changes to diet and physical activity to achieve weight loss) led to significant reductions in the cumulative incidence of type 2 diabetes. In the US diabetes prevention programme trial, at ten years incidence of type 2 diabetes in the intensive lifestyle intervention was 4.8 cases per 100 person years (95% CI 4.1 to 5.7) compared to 11.0 (95% CI 9.8 to 12.3) in the control group. Similarly, in the Finnish diabetes prevention programme trial, at 13 year follow-up the group randomized to the intensive lifestyle intervention sustained a significantly lower incidence of diabetes compared to a minimal control group (adjusted hazard ratio 0.61, 95% CI 0.48 to 0.79).

In addition to onset of type 2 diabetes, weight loss benefits a number of other clinical conditions. Weight loss has been observed to have a linear relationship to lipids in people with overweight and obesity; for every 10 kg weight loss a reduction of 0.23 mmol L⁻¹ in total cholesterol may be observed, reducing cardiovascular risk.(60) Weight loss is also linearly related to reductions in blood pressure; models suggest that for 10 kg of weight loss, decreases of 4.6 mmHg diastolic and 6.0 mmHg systolic may be expected.(61) The American Association of Clinical Endocrinologists and American College of Endocrinology have recently systematically reviewed evidence on the degree of weight loss associated with clinically significant improvements in a myriad of health conditions. Where relevant, they have also outlined specific guidance for behaviour change interventions for weight loss in each condition.(62) These are summarised in Table 1, where degree of weight loss is represented by percentage thresholds. All of these figures presume weight loss is maintained; however, promisingly, data are beginning to emerge which suggest that, even in the face of weight regain, health benefits from initial weight loss may prevail, particularly in people at elevated risk of

developing type 2 diabetes and in people with atrial fibrillation.(58, 59, 63) However, this area of research is relatively underdeveloped, and more definitive analyses are needed to test the mitigating impacts of weight regain on the benefits of initial weight loss.

Table 1 Therapeutic benefits of weight loss in patients with overweight or obesity(62)

Condition	Amount of weight loss required	Notes re: possible lifestyle interventions
Asthma/reactive airway disease	7% to 8%	No specific recommendation
Depression	None defined	“should be offered a structured lifestyle intervention”
Dyslipidaemia (elevated triglycerides and reduced HDL cholesterol)	5 to 10% as needed to achieve therapeutic targets	Should include a physical activity program and reduced-calorie healthy meal plan that minimizes sugars and refined carbohydrates, avoids trans fats, limits alcohol use, and emphasizes fibre
Female infertility	≥10%	No specific recommendation
Gastroesophageal reflux disease	≥10%	No specific recommendation
Hypertension	>5% to 15%	Should include caloric reduction and physical activity
Male hypogonadism	5% to 10%	No specific recommendation
Non-alcoholic fatty liver disease	4% to 10%	Caloric restriction and moderate-to-vigorous physical activity
Obstructive sleep apnoea	7% to 11%	No specific recommendation
Osteoarthritis	≥10%	Must include physical activity programme
Polycystic ovarian syndrome	5% to 15%	No specific recommendation
Type 2 diabetes (established)	5 to 15% as needed to lower HbA1C	Should be considered regardless of duration or severity of disease
Type 2 diabetes (risk of developing) (people with ‘prediabetes’, metabolic syndrome, or ‘high risk’ based on validated paradigms)	10%	Should include caloric reduction and physical activity
Urinary stress incontinence in women	5% to 10%	No specific recommendation

Box 3. A note on thresholds

As indicated in Table 1, thresholds (e.g. 5% weight loss) are often used to measure the impact of interventions. This is somewhat at odds with data suggesting that the relationship between excess BMI and increased health risks is broadly linear (32), that the relationship between weight loss and health outcomes is broadly linear (60, 61), and that smaller amounts of weight loss can lead to clinically significant benefits.(64) This can be reconciled by understanding the linear relationship at a population level, whereas thresholds may be more representative of what an individual may need to do to have a good chance of experiencing significant clinical benefits.

Though thresholds such as 5% may be useful, it is important that we do not lose sight of the benefits of weight loss at levels less than 5%. For example, a recent review evaluating the impact of weight loss interventions on cardiovascular risk factors found that even losses in the region of 0 to 2.5% of initial body weight led to statistically significant reductions in systolic and diastolic blood pressure, total cholesterol, low-density lipoprotein (LDL) cholesterol, HbA1c, and fasting plasma glucose.(64) The authors also conducted a meta-regression measuring changes in risk factors with every kg of weight loss; statistically significant results were found for systolic (-0.611 mmHG, 95% CI -0.973 to -0.248) and diastolic (-0.295 mmHG, 95% CI -0.575 to -0.015) blood pressure at 6 to 12 months, triglycerides at 12 to 24 months (-0.041 mmol L⁻¹, 95% CI -0.049 to -0.027) and at longer than 24 months (-0.212 mmol L⁻¹, 95% CI -0.393 to -0.031), fasting plasma glucose at longer than 24 months (-0.020 mmol L⁻¹, 95% CI -0.037 to -0.003), and HbA1c (%) at 12 to 24 months (-0.065%, 95% CI -0.111 to 0.018).

1.3.3 Options for intervention

The rise in obesity rates, the number of people trying to lose weight, and evidence on the health benefits of weight loss all point to the need for effective interventions.

However, overweight and obesity are complex phenomena, and as such, give rise to complex solutions. Interventions to target obesity may have different aims – prevention or treatment; may operate at different levels – population or individual; and may use a variety of means to achieve those aims. These are explored briefly below.

At a basic level, prevention of obesity is clearly more desirable than treatment – the vast majority of people suffering with a disease or risk factor would rather have not developed it in the first place. However, the UK Foresight report acknowledged that, though the prevention of obesity is vital, treatment is a key part of the overarching response given the significant numbers of people already requiring treatment and given that obesity rates will rise regardless of any short-term preventative measures.⁽²⁷⁾

Painting prevention and treatment options as a stark dichotomy may in fact be misleading – prevention efforts may well aid weight loss and weight loss maintenance, and vice versa – for example, a good weight gain prevention programme may help people who have lost weight maintain that weight loss.

Similarly, population and individual level interventions have the potential to complement one another. Though population level interventions, such as policy changes, clearly have scope to reach more people than individual level interventions, such interventions are often slow to develop, and in the meantime the number of people with obesity and obesity-related ill health continues to rise. Individual level interventions, which I focus on in this dissertation, are one option for treating obesity in the absence of, or alongside, effective population-level interventions. It is widely

recognized by the WHO and others that behaviour change interventions work best when deployed at multiple levels - individual-level behaviour change interventions, for example encouraging healthier diets, can only have their full effect in supportive environments – e.g. healthy eating interventions only work where healthy foods are available.(1, 34) The UK Foresight report highlighted the likely futility of isolated initiatives and need for approaches at multiple levels – individual, community, governmental and societal – in order to prevent further morbidity and mortality as a result of raised BMI.(27)

Box 4. A note on the focus of this research

This thesis explores individual level treatment interventions. There are some people who would disagree strongly with such a focus, and I am somewhat sympathetic to their arguments. The decision to explore these interventions was a pragmatic one – there are clear opportunities to improve people’s lives through these interventions and direct routes through which these interventions can be implemented. Given the sheer number of people trying to lose weight through self-directed means, interventions to enhance these individual efforts may also bring societal benefits. However, in focussing on individual level interventions I do not intend to send the message that such interventions alone can combat obesity. The role of the environment is crucial, and in an ideal world individual level efforts at changing behaviour would always be synergistically supported by changes in the environment. From a theoretical perspective, a focus on individual level interventions is often conflated with a viewpoint that places all responsibility for obesity and its related co-morbidities squarely on the shoulder of the individual – my focus on individual level interventions is in no way intended to endorse that viewpoint.

1.3.3.1 Options for intervention at the individual level

So what options exist for individual level treatment of obesity? In the UK NHS, different tiers of weight management services cover different activities to treat obesity. These rise in cost-per-individual from tier 1 up to tier 4. Exact definitions of what constitutes each tier vary at the local authority level, but typically:

- tier 1 covers universal services (e.g. health promotion or primary care);
- tier 2 covers behavioural weight management services (e.g. referrals to multicomponent weight management services such as Weight Watchers, also referred to as ‘lifestyle weight management services’);
- tier 3 covers specialist weight management services; and
- tier 4 covers bariatric surgery.(65)

Tiers 1 and 2 take the form of behaviour change interventions – namely interventions that aim to support change in people’s diet and/or physical activity through non-medical and non-surgical means.(56, 57) However, when implemented in primary care (e.g. tier 1 services), behavioural interventions for weight loss are often not effective.(66) Only a small proportion of people who may benefit are currently offered treatment or enrol in behavioural weight management programmes of the kind offered by tier 2 programmes.(66-70) This may be due in part to issues with availability, convenience and patient preferences.(71) Tier 3 services also include behaviour change interventions, but may also incorporate pharmacotherapy. However, most tier 3 and tier 4 services are only available to people who have already completed a tier 2 programme without satisfactory results and who have more severe obesity or comorbidities. The reality, therefore, is that most people trying to manage their weight do so on their own, without help from a formal weight loss programme.(56, 57)

1.4 Self-management

Given the high prevalence of overweight and obesity, the number of people trying to lose weight through self-directed means, and limited NHS resources with which to address the condition, there is a clear need for effective self-management options for individuals with overweight or obesity. However, despite the large number of people trying to lose weight on their own, little is known about self-directed efforts to lose weight, particularly in contrast to more intensive interventions.(68, 72, 73) To date, self-directed weight loss attempts have been largely under-researched; this thesis seeks to begin to fill this gap, and this section outlines relevant context on self-management.

1.4.1 Self-management as a movement

As a concept, self-management has been embraced by the NHS, who frame it as ‘involving people in their own care,’ which they may do independently or in partnership with a healthcare provider. The NHS has committed to this approach based on evidence that it can improve outcomes and patient experience, and can potentially yield efficiency savings, of great interest given current financial pressures on the healthcare system.(74) The evidence that the NHS draws on has been provided by a 2014 report from the King’s Fund¹ on patient activation, which refers to the knowledge, skills and confidence a person has in managing their own health and care. The report argues that, given the number of premature deaths caused by detrimental health behaviours, it is vital that people engage more with improving their own health, and introduces ‘patient activation’ as a way of conceptualising and measuring that engagement.(75)

¹ The King’s Fund is an English health charity that shapes health and social care policy and practice

Though the commitment of the NHS to the concept of self-management is clear, in practice the form this should take is somewhat nebulous. A 2015 report from the King's Fund, originally published in 2011 and updated since to reflect changes in the NHS, sets out priorities for healthcare commissioners. The report opens by stating that the NHS is currently facing 'the most challenging financial and organisational environment seen in decades' and argues that, in order to cope, health care commissioners must 'shift the current emphasis on acute and episodic care towards prevention, self-care and integrated and well co-ordinated care.' The first priority set out by the report is to provide active support for self-management.⁽⁷⁶⁾ However, the report lacks specific recommendations as to how to achieve this. Support for self-management has been described in two forms which are by no means mutually exclusive: as a portfolio of techniques and tools to help patients choose healthy behaviours (the portfolio approach), and as a transformation of the patient-caregiver relationship into a collaborative partnership (the partnership approach).⁽⁷⁷⁾ The King's Fund report leaves it open as to what path commissioners should take, making two general recommendations: that commissioners ensure the intervention is tailored to the condition, and that healthcare services give patients the opportunity to co-create personalised self-management plans.⁽⁷⁶⁾

Though the explicit commitment of the NHS to self-management is relatively new, the concept of an informed, empowered patient supported to self-manage is not a new one. Such a patient has been conceptualised to be at the heart of the chronic disease management model for the past two decades, and there are many examples of conditions in which interventions to support self-management have led to better outcomes and lower levels of healthcare utilization.⁽⁷⁸⁾ Most commonly, these examples are drawn from interventions implemented in populations with chronic diseases with behavioural

components, for example diabetes, hypertension, and arthritis, and in behavioural risk factors, such as smoking, where interventions often target participants prior to the onset of disease. As illustrated in systematic reviews and randomized controlled trials, in each of these examples, effective ‘self-management’ interventions range from those which rely heavily on the involvement of healthcare providers (partnership approach) to those which simply provide patients with additional materials aimed at improving their knowledge and capability to self-manage their conditions and improve their health (portfolio approach).(79-83)

1.4.2 Self-management in obesity

Both partnership and portfolio approaches to self-management can be and are used to treat obesity. In terms of partnership approaches, behavioural weight management services could be conceptualised as one option, as could advice from a healthcare provider. In the UK, commercial weight loss groups such as Weight Watchers and Slimming World are popular and can be referred to from the NHS as tier 2 services. Systematic reviews have shown these to be effective.(66-70) However, as discussed above, in the recent systematic review of the global prevalence of weight management attempts, prevalence of use of such programmes was estimated at only 6% among those trying to lose weight. Rates of consultation with healthcare professionals regarding obesity also appear to be relatively low: in the recent review, thirteen percent of people had discussed weight management with their doctor (see 1.3.1).(51)

In the absence of, or alongside, formal programmes or professional support, people trying to lose weight may also turn to portfolio type approaches to self-management.(51, 71) This may take the form of online content, programmes, or groups, mobile phone based apps, and print materials including magazines and books. Data

from the last five years suggest such interventions are being widely used: the global weight loss market is expected to reach over 200 billion USD by 2019; weight loss books frequently feature in best seller lists; 33% of US internet users look online for information about weight management; 19% of smartphone owners are estimated to have a health app on their phone, with the most popular type being diet, exercise, and weight apps; and 60% of American adults report tracking their weight, diet, or physical activity online.(84-87) Unpublished data from a nationally representative sample in Europe found that 15% of people trying to lose weight reported using some sort of ‘self-help’ material (see 1.3.1).(57) Weight loss blogs also abound – individual blogs may have thousands of followers. However, much of this material, including that with the highest usage, is not evidence based.(88) This is not to say there are no evidence based resources available, but those that are, such as government or charity provided resources, tend to be grounded on evidence from more intensive interventions, reflecting many of the difficulties inherent in studying self-management (explored further in Chapter 7).

Given the rise in obesity prevalence, its associated comorbidities, and current government emphasis on self-management, there is a clear need to develop and test self-management tools that could be used within the ‘portfolio’ approach to self-management described above – namely a suite of techniques and tools to help people change their behaviours. However, evidence in this area is largely lacking, and this has a profound impact on the availability of resources to help people in self-guided weight loss attempts. My hope is that the research contained in this dissertation will begin to help fill this gap in the evidence.

1.5 Understanding behaviour change

As described above, the most common approaches to preventing and treating obesity involve non-medical and non-surgical methods that aim to change people's eating and physical activity behaviours. However, changing these behaviours is complex – it is clearly not as simple as just informing someone that if they eat less and exercise more they will lose weight. My dissertation focusses specifically on behavioural approaches, seeking to increase understanding of the inherent complexities involved at the level of individual implementation.

There is currently an absence of evidence regarding behaviour change strategies used by individuals embarking on self-directed weight loss attempts. Those studies of self-directed weight loss that have been conducted tend to focus on energy intake and expenditure and their relationship to weight loss, rather than on the behavioural strategies individuals use to help them achieve a negative energy balance, which are arguably more relevant.^(53, 56) One American cohort, the National Weight Control Registry, has focussed more on the techniques used, but only in a very specific sample: those who have lost at least 13.6 kg (30 lbs) and maintained that loss for at least a year.⁽⁸⁹⁾ This study has highlighted the potential role of consistent self-monitoring, diet consistency, and relatively minimal television viewing in sustaining long-term weight loss, but the techniques used in participants with a range of weight loss and regain trajectories have yet to be fully evaluated.⁽⁹⁰⁻⁹³⁾

In the absence of such evidence, the approach to evaluating the behavioural strategies used by individuals in weight loss attempts can be informed by research in related fields. Most relevant are behavioural weight management programmes. We know, from

reviews I and others have conducted, that such programmes can lead to significant weight loss in adults with overweight or obesity at a year or longer. However, these reviews also made clear that not all interventions were the same – even where interventions were restricted to those that included diet, physical activity, and multiple sessions of behavioural counselling, effectiveness varied widely and could not be fully explained by differences in study populations, aspects of intervention delivery, or the diet and physical activity recommendations made by the programmes.(66-68)

In the face of this unexplained variation, there has been increased interest in assessing the content of behaviour change interventions – specifically, the behaviour change techniques delivered by interventionists, but also in some cases evaluating changes in individual behaviour resulting from these techniques. Breaking interventions down into these components can give a better picture of what the ‘active ingredients’ of an intervention may be – and indeed may also identify inactive or harmful ingredients that could be left out of future interventions. Understanding these intervention components is crucial to informing intervention design and delivery (for further discussion, see Chapter 2).(94, 95)

Understanding the techniques which may help an individual change his or her behaviour is of great relevance to weight loss research – whereas previous research has focussed on the nutrient profile of a variety of diets, it increasingly appears that adherence to a hypoenergetic diet may be more important than precise nutrient composition when it comes to weight loss.(96, 97) For example, in a 2009 trial published in *The New England Journal of Medicine*, participants were randomly assigned to one of four diets which varied based on the targeted percentages of energy derived from fat, protein and carbohydrates. Whilst weight loss was not significantly different between any groups,

adherence related measures were strongly associated with weight loss regardless of group.(97) Increasingly, therefore, the behavioural strategies that influence energy intake and expenditure have come to the attention of researchers as one possible factor contributing to the success, or otherwise, of weight loss attempts. In recent years, these have been evaluated in the context of behavioural weight management programmes through meta-regressions conducted as part of systematic reviews. In these analyses, calorie counting, comparisons of behaviour between participants, self-monitoring, goal setting, relapse prevention and prompting practice have been found to be associated with greater weight loss.(68, 73, 98)

Though this evidence is limited as it is derived primarily from indirect comparisons, it can highlight potentially promising behaviour change techniques for weight loss interventions. However, behaviour change techniques that work in intensive, face-to-face interventions may well work differently in self-guided weight loss attempts, and indeed some are not relevant outside of the context of formal interventions. As mentioned earlier, evidence on behaviour change strategies from the National Weight Control Registry is limited due to the narrow scope of participants included and its focus on weight loss maintenance rather than initial weight loss. There is therefore a strong need for further research into the cognitive and behavioural strategies that individuals use in self-guided weight loss attempts, across a wide array of weight change trajectories.

1.6 Aims and objectives of this research

Given the prevalence and associated health burdens of overweight and obesity, the benefits of weight loss, the number of people trying to lose weight through self-directed

means, the demonstrated effectiveness of interventions to support self-management in other conditions (e.g. chronic diseases such as diabetes and hypertension (79, 80)), and NHS buy-in to the concept and role of self-management in the current healthcare environment, the need for more research into self-management of weight in the UK is clear. This is particularly the case when we consider the potential scalability of interventions aimed at improving effectiveness of self-guided weight loss attempts.

As discussed above, however, the question is no longer *what* works for weight loss – we know negative energy balance is the target – but *how* best to achieve this. The objective of this dissertation, therefore, is to examine a previously underexplored area – namely, to hone in on the cognitive and behavioural strategies used by adults with overweight or obesity to lose weight and maintain that weight loss, particularly in self-guided weight loss attempts, and to test the relationship between use of these strategies and weight loss success. Eventually, it is hoped that evidence gleaned from this research could be used to develop new interventions to enhance the success of self-directed weight loss efforts.

The chapters contained in this thesis all directly map on to the objectives set out above, and are summarized briefly below.

- Chapter 2 describes the need for, and development and testing of, a new taxonomy and questionnaire to categorise and identify the cognitive and behavioural strategies used by individuals trying to lose weight.
- Chapter 3 presents a systematic review and meta-analysis of self-help interventions for weight loss, in which intervention characteristics are coded using the taxonomy developed in Chapter 2.

- Chapter 4 describes the design and results of an observational cohort study which used the questionnaire developed in Chapter 2 to examine the cognitive and behavioural strategies used for weight loss in a sample of the UK population and test associations between strategy use and weight change.
- Chapter 5 presents a systematic review of qualitative literature relating to self-directed weight loss attempts, with a particular focus on evaluating the cognitive and behavioural strategies as categorized by the taxonomy developed in Chapter 2.
- Chapter 6 explores qualitative literature from the above review in more depth, focussing on the most prevalent group of strategies (self-monitoring) and examining participant experiences of these strategies using thematic synthesis techniques.
- Chapter 7 is the discussion chapter of this dissertation, and draws together findings from the previous chapters to point to areas for future research and possible intervention design.

Chapter 2 Development of the Oxford Food and Activity Behaviours

(OxFAB) taxonomy and questionnaire

2.1 Summary

This chapter describes the development of the Oxford Food and Activity Behaviours (OxFAB) taxonomy and questionnaire, designed to explore the cognitive and behavioural strategies used by individuals during weight management attempts. The taxonomy was constructed through a qualitative analysis of existing resources and a review of existing behaviour change taxonomies and theories. It was then translated into a questionnaire to identify strategies used by individuals. Think aloud interviews were conducted to test the face/concept validity of the questionnaire and test-retest reliability was assessed in a sample of 138 participants. The resulting taxonomy (version 1 of the OxFAB taxonomy) consists of 117 strategies grouped into 21 domains. Compared to taxonomies used to describe interventions, around half of the domains and strategies identified were unique to the OxFAB taxonomy. The OxFAB questionnaire consists of 117 questions, one for each strategy from the taxonomy. Test-retest resulted in a mean prevalence-adjusted bias-adjusted kappa (PABAK) score of 0.61 (standard deviation (SD) 0.15). Questions were revised where appropriate. The OxFAB taxonomy and questionnaire provide a conceptual framework to identify the cognitive and behavioural strategies used by individuals during attempts at weight control.

Note: A version of this research has been published by the journal *Obesity*.(99)

2.2 Introduction

As touched upon in Chapter 1, weight management research has begun to address not only *what* changes in diet and physical activity are needed, but *how* these changes are made and maintained. Recently, behaviour change interventions targeting obesity have become increasingly complex and have begun to show promise.(68, 100) At the same time, national and international guidance on developing and evaluating complex and non-pharmacological interventions have called for classification of the specific intervention techniques used in such programmes.(95, 101) CONSORT guidelines on reporting behavioural interventions now specify that trialists must describe the different components of the intervention, including the content of each session and the content of the information exchanged with participants.(101)

To address this call for clearer reporting of behavioural interventions, behaviour change technique taxonomies have been developed, which can be instrumental in categorizing intervention components, establishing a common language, identifying active ingredients, and translating effective interventions into practice.(94) In particular, Michie and colleagues have created a number of behaviour change taxonomies; their most recent taxonomy, designed to apply to a range of behaviour change interventions, includes 93 items.(94) In addition to subject-agnostic taxonomies, taxonomies of behaviour change techniques intended for particular issues, including smoking cessation and weight management (most recently, the CALO-RE taxonomy) have been developed.(102, 103) Subject-specific taxonomies take into account those behaviours which are relevant only to certain behaviour change targets (e.g. smoking cessation) and which would be missed by a subject-agnostic taxonomy.

One limitation to existing behaviour change taxonomies, however, is that they have been designed for the purpose of categorizing, designing, and conducting interventions. They adopt an interventionist-centred approach, classifying behaviour change techniques that an interventionist may deliver within a programme, rather than the behavioural strategies an individual enacts. In some cases the two approaches may relate closely to each other e.g. goal setting or self-monitoring, but many other strategies may be specific to techniques deployed by an individual. Self-managed attempts to change behaviour are arguably as complex as externally delivered interventions, yet efforts to classify components of self-directed behaviour change attempts have yet to be approached in as systematic a manner.

Identifying effective personal strategies for weight management is important given the large number of adults trying to lose weight, as described in Chapter 1. Despite the growing popularity of online and mobile applications to support self-directed weight management attempts (85-87), investigations into the content of self-help resources have found that they are largely lacking in evidence-based content.(88, 104) Of those resources that are evidence based, evidence often comes from intensive interventions and it is conceivable that strategies recommended in these settings may not be as effective outside the context of these intensive interventions. This paucity of empirical evidence makes it difficult for individuals, researchers, and practitioners to identify those strategies which have been shown to be effective.

Existing questionnaires designed to explore weight-related behaviours in individuals are unable to fill this gap, as they primarily focus on quantifying and qualifying energy intake and expenditure (how much and what kind), e.g. DINE (70) or IPAQ (105), measuring the end result of a myriad of behaviours as opposed to the cognitive and

behavioural strategies individuals adopt and which lead to the recorded diet and activity levels.(105-107) The lack of a common framework with which to categorize and evaluate the specific actions taken by individuals for the explicit purpose of weight management hampers the ability of researchers to identify which cognitive and behavioural strategies are deployed and those which may be effective for weight loss. The OxFAB taxonomy and questionnaire seek to fill this gap, and as such are the building blocks of this thesis. As will be demonstrated in subsequent chapters, the OxFAB taxonomy informed the qualitative and quantitative systematic reviews (contained in Chapters 3, 5 and 6), and the OxFAB questionnaire was used in the OxFAB cohort study (Chapter 4). This chapter introduces the taxonomy and questionnaire, outlining the initial stages of their development.

2.3 Methods

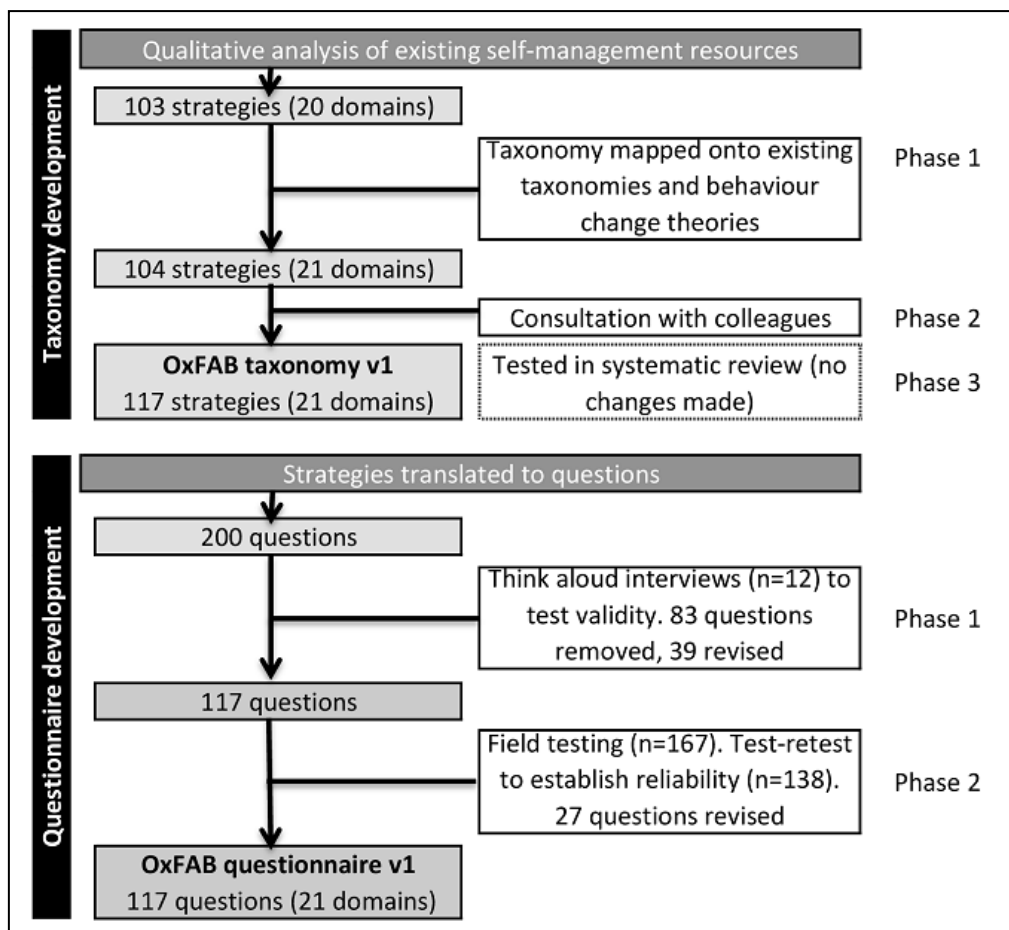
Methods for taxonomy and questionnaire development are summarized in Figure 1 and described in more detail below. A crucial point to bear in mind whilst reading this chapter is that taxonomies are evolving structures, and hence the taxonomy and questionnaire presented here, and the steps taken to develop them, refer to the first version of the OxFAB tools. It is anticipated that subsequent versions will be developed in due course.

2.3.1 Taxonomy development

The development of version 1 of the OxFAB taxonomy was a three-phase process. Firstly, a preliminary list of domains relating to weight management was developed, within which are several strategies which share a common characteristic relating to the domain. Secondly, the domains and strategies were compared and contrasted with

existing taxonomies and theories and refined accordingly. Thirdly, I used the initial version of the taxonomy to categorise interventions in a systematic review of self-help interventions for weight loss, to test and improve ease of use and to identify any further categories, alongside a second reviewer (see Chapter 3).(69) The latter two stages drew on the approach used by Michie and Abraham in their initial development of the Behaviour Change Technique Taxonomy.(108) Each of these stages is described in further detail below.

Figure 1 Flow diagram outlining item generation, reduction, and refinement for version 1 of the OxFAB taxonomy and questionnaire



2.3.1.1 Phase 1. Building the initial taxonomy

2.3.1.1.1 Extracting initial strategy list

A qualitative analysis of existing weight management resources was conducted to extract individual strategies. I evaluated government resources, representing the standard advice for weight management, and the most popular commercial resources based on UK sales and usage data (Table 2). It was not practicable to seek to be comprehensive in the resources reviewed, but I aimed to ensure key strategies were captured, discussing with my supervisors throughout. Reviewing of further resources was stopped when saturation was reached.

Table 2 Self-management resources used in qualitative framework analysis

Source title	Format	Accessed	Source type	Home page (if relevant)
Boots/WebMD Diet and Weight Loss Guide	Website	14.10.13	Commercial	www.webmd.boots.com/diet/guide/diet-weight-loss-losing-weight
Cancer Research UK, 10 Top Tips	Print	Published 2011	Charity	n/a
MyFitnessPal	App/web	10.10.13	Commercial	www.myfitnesspal.com
NHS Choices 12-week guide	Website	30.9.13	Government	www.nhs.uk/Livewell/weight-loss-guide/Pages/weight-loss-guide.aspx
Rosemary Conley	Website	6.11.13	Commercial	www.rosemaryconley.com
Slimming World	Website	6.11.13	Commercial	www.slimmingworld.com
Weight Watchers	Website	6.11.13	Commercial	www.weightwatchers.co.uk ²

Strategies were defined as the cognitive and behavioural techniques adopted by an individual for the specific purpose of weight management. I did not include strategies that would be considered clinically contra-indicated, e.g. purging. Following the approach set out by Michie et al, individual strategies were required to be replicable,

²Additional information also provided from company as part of previous research project

irreducible (e.g. non-overlapping and non-redundant) and mutually exclusive.(94) I aimed to be as comprehensive as possible within the defined scope.

2.3.1.1.2 Constructing the taxonomy

The Framework Method was used to translate the raw data into the initial version of the taxonomy. This method is a type of thematic analysis which can be used to draw descriptive or exploratory conclusions clustered around themes, and is particularly useful where multiple researchers are working on a project.(109) Though traditionally used for analysing semi-structured interviews, it can also be used in analysis of textual data, as was done in this case.(110) The Framework Method was selected due to a number of its merits, namely: it is flexible enough to be used for non-traditional qualitative data; the charting process allows people from many different disciplinary backgrounds to engage with the data and offer perspectives without familiarising themselves with all of the original data; it can be used in both deductive and inductive analyses, or in a combination of the two; and it provides a clear audit trail from original data.(109)

An inductive approach was initially taken, with individual strategies extracted verbatim, and grouped into larger categories to form a hierarchically structured taxonomy (the analytical framework).(110) During the framework analysis, two distinct forms of categorization emerged: domains were defined as those categories which were the lowest grouping possible above the level of the individual strategy, for example, “self-monitoring”; and cross classifications were defined as threads that ran through numerous domains, in this case “food” and “physical activity.” The framework was translated into a list of domains (e.g. “self-monitoring”) to which the cross-classifications could be applied.

Once the initial list had been developed through the inductive framework approach, colleagues in several different departments and institutions with expertise in weight management and behaviour were consulted to identify additional strategies and domains. Each domain was considered individually and strategies within that domain were brainstormed. Strategies that were not already covered were considered by myself and my supervisors and either added to an existing domain or a new domain was created.

2.3.1.2 Phase 2. Evaluating the taxonomy in light of existing theory

Whereas phase 1 primarily relied on inductive methods to build up an initial version of the taxonomy, phase 2 took a deductive approach, drawing on existing theory. The overarching strategies were evaluated in the light of existing behaviour change taxonomies (the 93-item behaviour change taxonomy and the CALO-RE taxonomy) at the level of both individual techniques and domains to determine if any groups of strategies had been missed.(94, 102) Domains from the OxFAB taxonomy were also mapped onto existing theoretical frameworks of behaviour change, including learning theories, social cognitive theory (111), the theory of reasoned action (112), the theory of planned behaviour (113), the health action process approach (HAPA) (114), and the PRIME theory of motivation.(115) Table 3 contains brief summaries of each approach. For example, planning elements of the taxonomy were mapped onto the behavioural intention component of the theory of reasoned action, and the pre-action stage of the HAPA approach. Having mapped from the domains to the theories, reverse mapping from the theories to the domains was conducted to examine whether any elements had been missed.

Table 3 Summary of theoretical frameworks of behaviour change used to evaluate initial OxFAB taxonomy

THEORY	KEY CONCEPTS
Health Action Process Approach	Series of continuous, self-regulatory processes: goal setting and goal pursuit <pre> graph LR Motivation[Motivation (goal-setting/ intention formation)] --> Volition subgraph Volition subgraph Pre-action AP[Action planning] CP[Coping planning] end subgraph Action Initiative[Initiative] Maintenance[Maintenance] Recovery[Recovery] end end </pre>
Learning theories	Complex behaviour learned gradually through modification of simpler behaviours; replication of behaviours of others <pre> graph LR Imitation[Imitation] --> Reinforcement[Reinforcement] --> Reward[Reward] </pre>
Prime Theory of Motivation	Three central ideas: wants and needs at moment drive behaviour; intention and beliefs only influence actions if create sufficiently strong wants and needs; self-image/identity is strong source of wants and needs which can overcome biological drives <pre> graph LR EE[External environment] --> Plans[Plans (intentions)] Plans --> Eval[Evaluations (beliefs)] Eval --> Motives[Motives (wants, etc)] Motives --> Impulses[Impulses (urges, etc)] Impulses --> Responses[Responses] Responses --> EE Responses --> Impulses Impulses --> Motives Motives --> Eval Eval --> Plans </pre>
Social cognitive theory	<pre> graph TD Behaviour[Behaviour] --> Environment[Environment] Environment --> Behaviour Behaviour --> Cognition[Cognition] Cognition --> Behaviour Environment --> Cognition Cognition --> Environment subgraph Central SE[Self-efficacy] GS[Goal setting] SR[Self-regulation] OE[Outcome expectations] OLM[Observational learning/modelling] end </pre>
Theory of planned behaviour	As per theory of reasoned action, but additional predictor: perceived behavioural control <pre> graph LR A[Attitude towards behaviour] --> Plus1[+] SN[Subjective norm] --> Plus1 Plus1 --> Plus2[+] PBC[Perceived behavioural control] --> Plus2 Plus2 --> BI[Behavioural intention] </pre>
Theory of reasoned action	<pre> graph LR PA[Personal attitude] --> BI[Behavioural intention] SP[Social pressure (subjective norm)] --> BI BI --> POB[Performance of behaviour] POB --> BC[Behaviour change] </pre>
Trans-theoretical	<pre> graph LR PC[Pre-contemplation] --> C[Contemplation] --> P[Preparation] --> A[Action] --> M[Maintenance] </pre>

2.3.1.3 Phase 3. Applying the taxonomy

In phase 3, a simple coding manual was developed, listing the domains, with definitions agreed through discussion, and examples added to aid comprehension. Its use was piloted in a systematic review of randomized controlled trials of self-directed interventions for weight loss in adults with overweight or obesity (see Chapter 3).(69) Two reviewers (myself and a second reviewer not previously familiar with the taxonomy) independently coded each intervention by domain and, within that domain, by cross classification, as yes, no, or unclear for recommendation of that strategy. Unclear was used where it was agreed the strategy was implied, but not explicitly stated, an approach used in previous reviews.(68) Table 4 shows an extract of the checklist used. Domains where agreement was low were identified, definitions were adjusted in an iterative process, and examples added to produce the working taxonomy.

Table 4 Extract from coding checklist

Domain	Definition	Cross-classifications			Notes (p#)
		Food	Activity	Other	
Energy compensation	Conscious adjustment of behaviours to alter energy intake and/or expenditure in light of previous energy intake or expenditure Example: If you've eaten a lot, exercise more to make up for it				
Imitation (modelling)	Emulating the physical activity or dieting behaviour of someone who you have observed Example: Choose to go on a certain diet because someone you know lost weight using the same approach				

After piloting the coding manual for use classifying interventions tested in randomized controlled trials (Chapter 3), the coding manual was also used in a qualitative

systematic review (see Chapters 5 and 6), which was conducted after version 1 of the taxonomy was agreed and published.

2.3.2 Questionnaire development

Once the working taxonomy was agreed, the 117 strategies were translated into a questionnaire for use by individuals. Initially, multiple questions were developed for single strategies and refined as a result of the pilot testing. Pilot testing was performed in two phases: firstly, qualitative testing of the questions using the think aloud technique (a form of cognitive interviewing) to test face validity, to select the optimal question for each strategy, and to refine the wording to produce a field-test version; and secondly, a quantitative web-based test-retest study to assess reliability. Both phases of questionnaire development were approved by the University of Oxford Central University Research Ethics Committee (think aloud MSD-IDREC-CI-2014-087; test—retest MSD-IDREC-CI-2014-159) and all participants provided informed consent.

2.3.2.1 Phase 1. Think aloud (cognitive testing)

Think aloud is a form of cognitive interviewing that has been designed to provide verbal data about reasoning during set tasks.(116) Increasingly it is used as a method to establish validity during questionnaire development.(117, 118) Generally, modest sample sizes are used for cognitive testing of questionnaire design, with iterative testing rounds conducted where time and resources permit.(117)

Participants for this phase were recruited from a sample of volunteers drawn from the general public who volunteered for a television weight loss programme, and were selected through purposive sampling to ensure representation from men and women, a range of ages, and a range of educational attainment. To be eligible, participants were

required to be adults with overweight or obesity, resident in the UK, fluent in English, and currently trying to lose weight through changes to their diet, physical activity, or both. Interviews took place over the telephone or via Skype.

To reduce burden on the participants, each participant was only asked a portion of the total questions in the questionnaire (average 50 questions per participant). Questions were divided between participants to ensure each question was appraised by at least three participants. At the start of the interview, participants were asked to briefly detail the things they were doing to try to lose weight. The interviewer then read out each question, and asked participants to answer the question whilst talking through their reasoning. Where there were multiple questions for a single strategy, participants were asked to indicate which they preferred and why.

Interviews were audiotaped and transcribed. The transcripts were analysed, with responses coded by question. Where the reasons given for responses were not congruent with the intent of the question, questions were rephrased. Where multiple questions existed for one strategy, the question with participant responses that were most congruent with the question's intent were selected. A final open question enabled participants to share further thoughts on the questionnaire; these were coded and analysed separately. Participants were also asked what response options they felt would be suitable for the multiple choice questionnaire (yes/no or a more graded approach).

2.3.2.2 Phase 2. Test-retest

After revision in line with think aloud responses, the questionnaire was administered online in a multiple choice format including 117 questions about self-management strategies (one question per strategy). Response options included: most of the time;

sometimes; never or hardly ever; not relevant to me; and unclear. Participants were recruited from a sample of volunteers drawn from the general public who volunteered for a television weight loss programme, through the charity Weight Concerns' Big Panel, an online panel of people with experience of being overweight (www.weightconcern.org.uk/node/21), and through snowball sampling using people who had participated in previous research. Inclusion criteria were the same as those used for the think aloud phase.

The target sample size was 130 participants, based on a sample size calculation of 126 to achieve 80% power to detect a kappa of at least 0.41 (considered moderate agreement).(119) This threshold was chosen as, given the nature of the questionnaire, some genuine changes in behaviours were expected. Participants were asked to repeat the questionnaire one to two weeks after initial completion. Using data from the first and second testing rounds, the prevalence index, the bias index and the PABAK (prevalence and bias adjusted kappa) were calculated using Stata v11.2.(120)

Multiple choice answers were coded as yes (including responses marked as 'most of the time' or 'sometimes') and no (including 'never or hardly ever' and 'not relevant to me'). Questions where test-retest resulted in PABAK scores lower than 0.41 were re-evaluated and rephrased as appropriate.(121) Using only the first round of participant responses to avoid double counting, questions where more than one participant selected 'unclear' were also revisited and rephrased.

2.4 Results

2.4.1 Taxonomy

2.4.1.1 *Comparison of OxFAB taxonomy with 93-item Behaviour Change Technique Taxonomy (94)*

The initial coding (Phase 1) yielded a list of 103 strategies grouped into 20 domains. Compared with existing taxonomies, there was some direct overlap, for example, self-monitoring.(7, 8) Of the 21 final domains, 13 included strategies which could not be mapped onto existing taxonomies. When mapped against the most recent, 93-item behaviour change technique taxonomy (7), approximately half of the OxFAB strategies could not be mapped directly on to the behaviour change technique (BCT) taxonomy (see Table 5). Three OxFAB strategies overlapped exactly with techniques from the BCT taxonomy (e.g. “Pledge/ agree to contract regarding your weight loss targets” is conceptually the same as BCT 1.8 Behavioural contract), 54 OxFAB strategies provided grounded examples of BCTs from the perspective of the participant (e.g. “Measure the amount of physical activity you do” is a grounded example of BCT 2.3 Self-monitoring of behaviour), 23 OxFAB strategies did not map onto any specific techniques but were related to concepts present in the BCT taxonomy (e.g. “Enhance accountability to buddy” is related to BCT category 3, Social support), and 37 OxFAB strategies were not related to concepts itemized in the BCT taxonomy, usually because of their specificity to weight loss (e.g. “Eat slowly”). The strategies in the OxFAB taxonomy tended to be more detailed and specific than the items in the BCT taxonomy, reflecting the different aims of the two taxonomies.

Table 5 OxFAB items mapped onto Michie et al. 's 93-item BCT taxonomy

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Adjust the amount you eat in response to how much you have eaten/will eat	Energy compensation	No comparable techniques
Adjust the amount you eat in response to the amount you have exercised/will exercise		No comparable techniques
Adjust the amount you exercise in response to how much you have eaten/will eat		No comparable techniques
Adjust the amount you exercise in response to how much you have exercised/will exercise		No comparable techniques
Set food intake targets	Goal setting	Grounded example (BCT technique 1.1 Goal setting (behaviour))
Set physical activity targets		Grounded example (BCT technique 1.1 Goal setting (behaviour))
Set weight targets		Grounded example (BCT technique 1.3 Goal setting (outcome))
Set one time targets		No comparable techniques (though broad conceptual overlap with Category 1 Goals and planning)
Set repeated time targets		No comparable techniques (though broad conceptual overlap with Category 1 Goals and planning)
Set achievable targets		No comparable techniques (though broad conceptual overlap with Category 1 Goals and planning)
Set body shape/size targets		Grounded example (BCT technique 1.3 Goal setting (outcome))
Copying the diet behaviour of others	Imitation (modelling)	Related but not direct map (BCT technique 6.1 Demonstration of the behaviour; 6.2 Social comparison)
Copying the physical activity behaviour of others		Related but not direct map (BCT technique 6.1 Demonstration of the behaviour; 6.2 Social comparison)
Copying the weight management behaviour of others		Related but not direct map (BCT technique 6.1 Demonstration of the behaviour; 6.2 Social comparison)
Accept feelings of hunger	Impulse management: acceptance	No comparable techniques
Accept cravings to eat		No comparable techniques
Accept uncomfortable aspects of physical activity		No comparable techniques

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Ask yourself if you are hungry when you find yourself wanting to eat	Impulse management: awareness of motives	No comparable techniques
Ask yourself if you are full when part way through a meal		No comparable techniques
Ask yourself why you feel like not being active		No comparable techniques
Find other activity to do when you feel like eating	Impulse management: distraction	Grounded example (BCT technique 12.4 Distraction)
Hold off eating when you have a craving to eat		No comparable techniques
Use physical distraction, e.g. gum shield after certain time to discourage further eating		No comparable techniques
Brush teeth to distract/reduce desire to eat		No comparable techniques
Go to sleep if feeling hungry		No comparable techniques
When I'm uncomfortable whilst being active, I do something to distract myself from the sensation		Grounded example (BCT technique 12.4 Distraction)
Seek information on food content/ energy	Information seeking	Related but no direct map (BCT Category 4 Shaping knowledge)
Seek information on calories burned during exercise		Related but no direct map (BCT Category 4 Shaping knowledge)
Seek information about how to manage weight		Direct map (BCT 4.1 Instruction on how to perform behaviour)
Record your motivation for losing weight	Motivation	No comparable techniques
Give yourself visual cue to remind yourself of motivation to lose weight (e.g. "fat pictures"/"slim pictures")		No comparable techniques
Track your progress using chart/graph/body size simulator		Related but no direct map (BCT 2.4 Self-monitoring of outcome(s) of behaviour)
Conscious appraisal of yourself to reinforce your actions (e.g. drawing on self-identity)		Related but no direct map (BCT Category 13 Identity; BCT Category 15 Self-belief)
Plan what you are going to eat (at home)		Grounded example (BCT 1.4 Action planning)
Bring food for meals when eating away from home	Planning content	Grounded example (BCT 12.1 Restructuring the physical environment)
Plan what you are going to eat when you are eating out		Grounded example (BCT 1.4 Action planning)
Prepare shopping list in advance		Grounded example (BCT 1.4 Action planning)

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Use recipes when cooking	Planning content, cont.	Related but no direct map (BCT 1.4 Action planning)
Carry healthy snacks for emergencies		Grounded example (BCT 12.1 Restructuring the physical environment)
Incorporate physical activity into commute to work		Grounded example (1.4 Action planning)
Find types of physical activity that you enjoy		No comparable techniques
Create exercise plan		Grounded example (BCT 1.4 Action planning)
Do more housework/gardening as a way of increasing activity		No comparable techniques
Allow yourself to eat unlimited amounts of certain foods/ drinks	Regulation: allowances	No comparable techniques
Allowing 'cheat' or 'treat' meals, times or days after restricting for a certain amount of time		Grounded example (BCT 10.1 Material incentive (behaviour))
Allowing physical activity free (or physical activity light) days after doing a certain amount of activity		Related but no direct map (BCT 10.2 Material reward (behaviour))
Avoid certain kinds of food	Regulation: restrictions	No comparable techniques
Don't eat foods you don't particularly like		No comparable techniques
Don't eat foods you like		No comparable techniques
Think in advance about how to politely turn down food		Related but no direct map (BCT 8.1 Behavioural practice/rehearsal)
Avoid eating in certain settings or at certain times		Related but no direct map (BCT 1.4 Action planning)
Avoid certain places where you might purchase food		Grounded example (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Do not eat out of the packet		No comparable techniques
Go out less		Grounded example (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Skip meals		No comparable techniques
Don't purchase certain types of food		Grounded example (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Avoid eating at certain times of day		No comparable techniques

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Purchase certain types of food	Regulation: rule setting	Grounded example (BCT technique 12.5 Adding objects to the environment)
Leave the table after eating		Grounded example (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Eat slowly		No comparable techniques
Leave food on the plate		No comparable techniques
Drink large glass of water or tea before meal to try and limit intake by feeling fuller quicker		No comparable techniques
Cut food into small pieces		No comparable techniques
Drink different type of alcohol/swap food for healthier option		Grounded example (BCT 8.2 behaviour substitution)
Maximise potential for physical exertion when being active		No comparable techniques
Accept some periods will exercise more dietary restraint than others (flexible)	Restraint	No comparable techniques
Rigid dietary restraint		No comparable techniques
Accept some periods will be more rigid about meeting physical activity targets than others		No comparable techniques
Rigid physical activity restraint		No comparable techniques
Reward yourself for hitting targets	Reward	Grounded example (BCT 10.9 Self-reward)
Set aside money at beginning and reward yourself by getting money back if you achieve your targets (contingency contracting)		Grounded example (BCT 10.9 Self-reward)
Plan when you are going to eat	Scheduling of diet and activity	Grounded example (BCT 1.4 Action planning)
Eat at set times (mealtimes)		No comparable techniques
Schedule doing your food shopping at a time when you are unlikely to be hungry		Grounded example (BCT 1.4 Action planning)
Eat at meal times even when you are not hungry		No comparable techniques
Eat before going food shopping		Grounded example (BCT 1.4 Action planning)

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Schedule physical activity	Scheduling of diet and activity, cont.	Grounded example (BCT 1.4 Action planning)
Give up something else to make time for physical activity		Grounded example (BCT 8.2 Behaviour substitution)
Exercise at times/in places where others are least likely to see you		Related but no direct map (BCT 1.4 Action planning)
Go to bed at a set time each night		Related but no direct map (BCT 1.4 Action planning)
Measure the content of your food	Self-monitoring	Grounded example (BCT 2.3 Self-monitoring of behaviour)
Measure the amount of your food		Grounded example (BCT 2.3 Self-monitoring of behaviour)
Measure the amount of physical activity you do		Grounded example (BCT 2.3 Self-monitoring of behaviour)
Monitor your fitness levels		Grounded example (BCT 2.4 Self-monitoring of outcome(s) of behaviour)
Weigh yourself		Grounded example (BCT 2.4 Self-monitoring of outcome(s) of behaviour)
Measure your waist size/other parts of your body		Grounded example (BCT 2.4 Self-monitoring of outcome(s) of behaviour)
Monitor tightness of clothes/ rings		Grounded example (BCT 2.4 Self-monitoring of outcome(s) of behaviour)
Avoid going into a shop when hungry	Stimulus control	Grounded example (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Use smaller plates or bowls		Related but no direct map (BCT 12.1 Restructuring the physical environment)
Choose food packaged in individual portion		Grounded example (BCT 12.1 Restructuring the physical environment)
Do not keep extra food on table		Grounded example (BCT 12.1 Restructuring the physical environment)
Purchase smaller quantities		Grounded example (BCT 12.1 Restructuring the physical environment)
Prepare healthy food in a way that makes it more appealing		Related but no direct map (BCT 12.1 Restructuring the physical environment)

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Store leftovers in portion controlled amounts	Stimulus control, cont.	Grounded example (BCT 12.1 Restructuring the physical environment)
Order small dish when eating out		Related but no direct map (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Keep unhealthy food/drinks out of the house		Grounded example (BCT 12.1 Restructuring the physical environment)
Give yourself cues to increase physical activity		Grounded example (BCT 7.1 Prompts/cues)
Give yourself cues to stand up/move when stationary		Grounded example (BCT 7.1 Prompts/cues)
Diet with a friend/family member	Support: buddying	Grounded example (BCT 3.1 Social support (unspecified/ BCT 3.3 Social support (emotional))
Exercise with a friend/family member		Grounded example (BCT Category 3 Social support)
Get support from a someone you didn't know previously who is also trying to lose weight		Grounded example (BCT 3.3 Social support (emotional))
Enhance accountability to buddy		Related but no direct map (BCT Category 3 Social support)
Ask people around you not to offer you foods you are trying not to eat	Support: motivational	Related but no direct map (BCT Category 3 Social support; BCT 12.3 Avoidance/reducing exposure to cues for the behaviour)
Ask people not to offer you foods you are trying not to eat		Related but no direct map (BCT 12.3 Avoidance/reducing exposure to cues for the behaviour; Category 3 Social support)
Attend an exercise group		Grounded example (BCT Category 3 Social support/1.4 Action planning)
Get family/friend support		Grounded example (BCT Category 3 Social support)
Get support from people you live with		Grounded example (BCT Category 3 Social support)
Pledge/ agree to contract regarding your weight loss targets		Direct map (BCT 1.8 Behavioural contract)
Commit to your weight loss plans in front of other people		Direct map (BCT 1.9 Commitment)
Seek help to help deal with feeling down, anxious or stressed	Support: professional help	Related but no direct map (BCT 3.3 Social support (emotional) and 11.2 Reduce negative emotions)
Belong to a weight loss group		Related but no direct map (BCT Category 3 Social support)
See healthcare professional about weight loss		Related but no direct map (BCT Category 3 Social support)

Strategy	Domain	Relationship to 93 item BCT taxonomy (7)
Get support from a dedicated weight loss service or professional	Prof. help, cont.	Related but no direct map (BCT Category 3 Social support)
Use meal replacements to control weight	Weight management aids	No comparable techniques
Purchase/use home exercise equipment		Grounded example (BCT 12.5 Adding objects to the environment)
Purchase gym membership		No comparable techniques
Purchase/use equipment to reduce sedentary time in office		Grounded example (BCT 12.5 Adding objects to the environment)

2.4.1.2 Mapping OxFAB taxonomy onto existing behaviour change theories

Figure 2 shows a complete picture of the domains being mapped onto the PRIME theory of motivation (115) and Figure 3 shows a complete picture of the domains being mapped onto the HAPA approach.(114) These two theories were chosen to illustrate the mapping process as they were the most relevant to the OxFAB taxonomy: learning theories and social cognitive theories focus more on single behaviours than describing a combination of strategies; the transtheoretical model is not relevant as the OxFAB taxonomy only relates to the ‘action’ stage; and the theory of planned behaviour and theory of reasoned action are not dual process.

2.4.1.3 Revised taxonomy

One additional domain was added during the process of mapping behaviour change taxonomies and theories onto the taxonomy. Prompted by social cognitive theory and learning theories, imitation (modelling) was added. Through discussions with colleagues, 11 additional strategies were also added. Accordingly, the OxFAB taxonomy (version 1) consists of 117 strategies grouped into 21 domains. Domain definitions can be found in Table 6 and the full list of strategies, grouped by domain, can be found in Table 7. The systematic review of self-help interventions resulted in minor changes to the coding manual to clarify definitions and examples, but did not uncover previously unidentified strategies, and did not result in substantive changes to the content of the taxonomy. Results from the systematic review are reported in Chapter 3 and have also been published elsewhere.(69) Results from the subsequent qualitative review, conducted after this version of the taxonomy was developed, can be found in Chapters 5 and 6.

Figure 2 Self-management strategies for obesity mapped onto elements of PRIME theory of motivation(115)

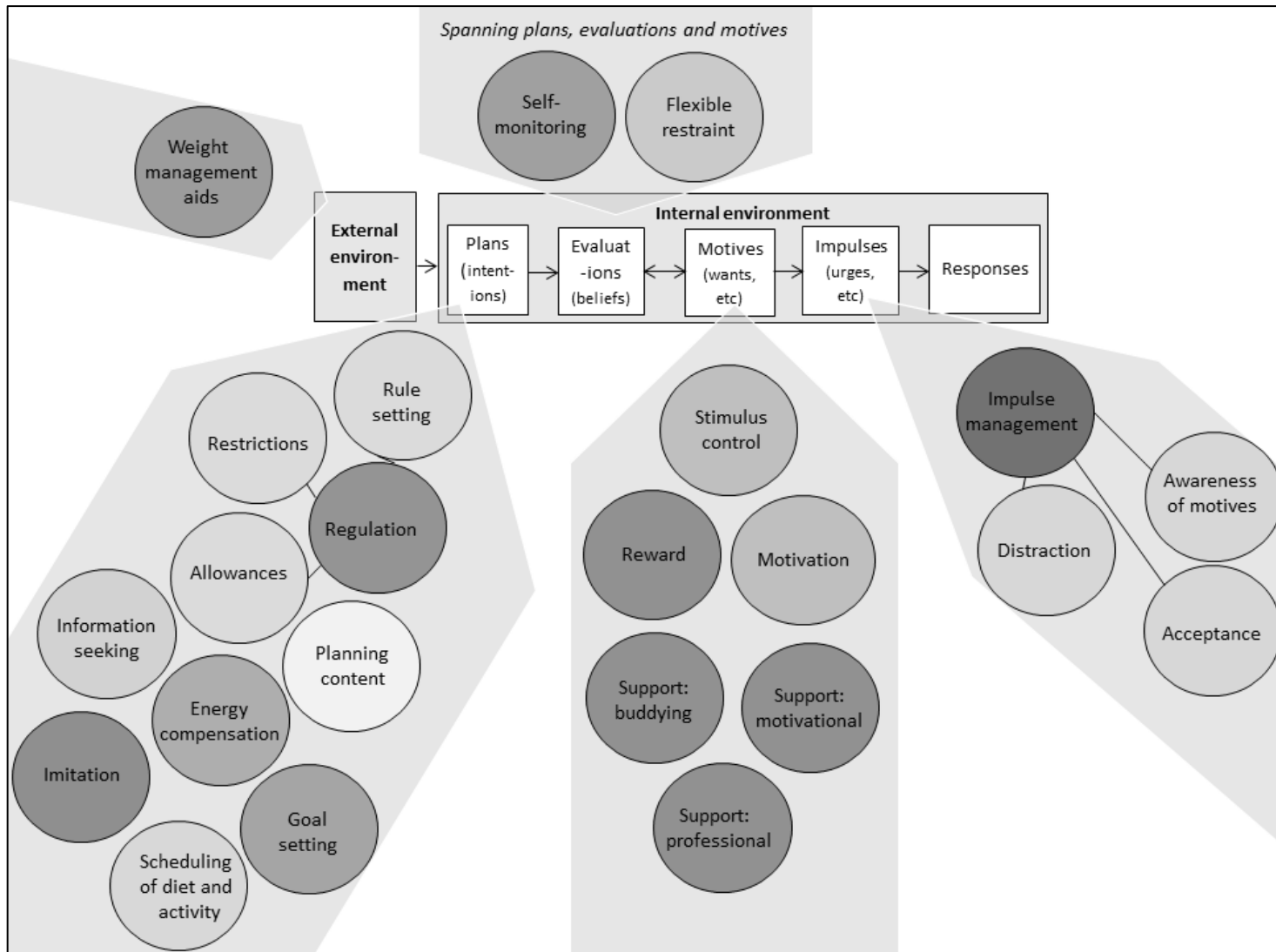


Figure 3 Self-management strategies for obesity mapped onto elements of HAPA(114)

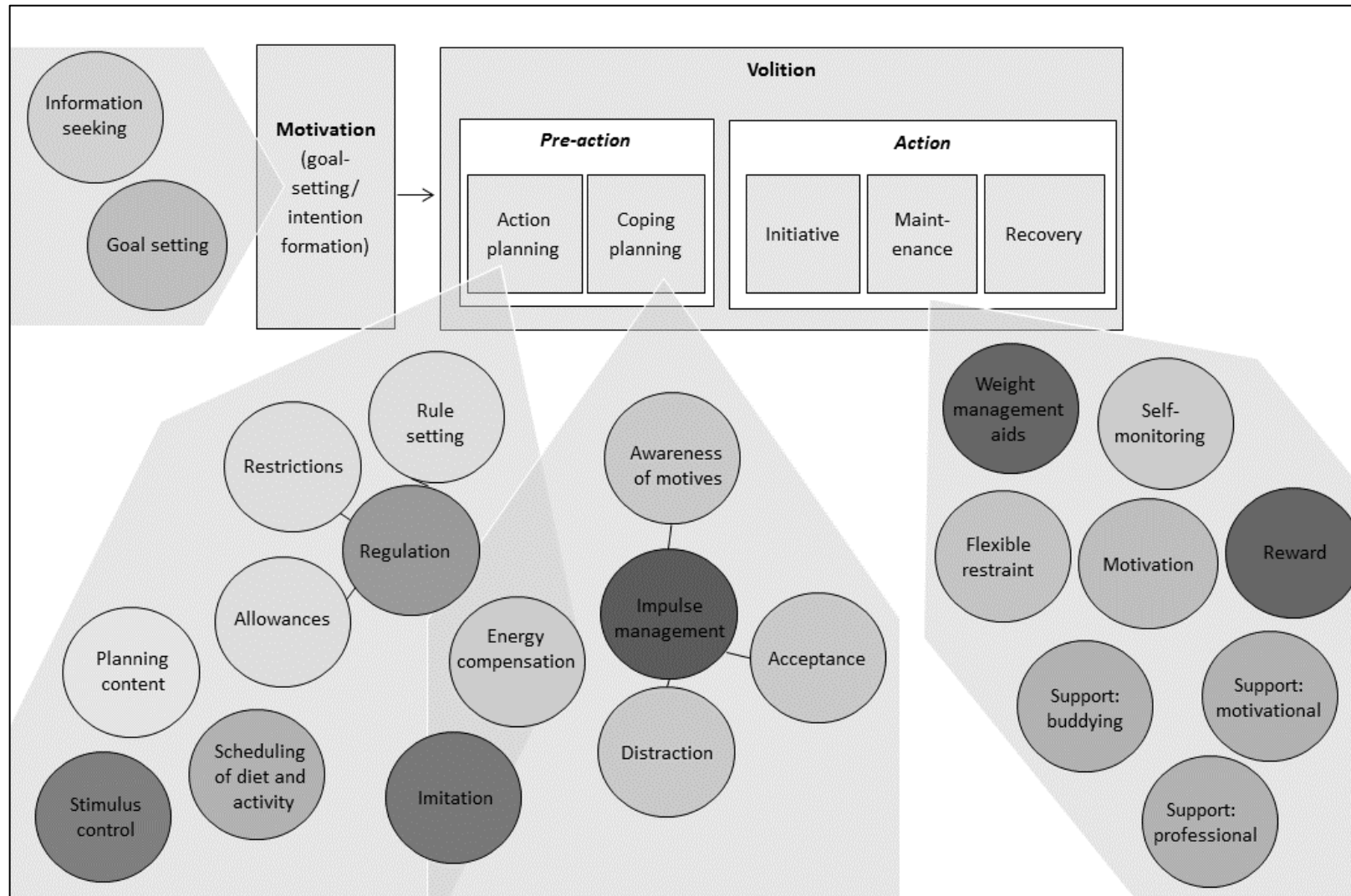


Table 6 Definitions of domains in the OxFAB taxonomy

Domain	Definition
Energy compensation	Conscious adjustment of behaviours to alter energy intake and/or expenditure to control weight in light of previous energy intake or expenditure
Goal setting	Setting of specific behavioural or outcome target(s)
Imitation (modelling)	Emulating the physical activity or dieting behaviour of someone who you have observed
Impulse management: Acceptance	Respond to unwanted impulses through awareness and acceptance of the feeling that generates the impulse and reacting without distress or over-analysis
Impulse management: Awareness of motives	Respond to unwanted impulses by evaluating personal motives behind that impulse before acting
Impulse management: Distraction	Respond to unwanted impulses through distraction in an attempt not to act on the impulse
Information seeking	Seek specific information to enhance knowledge to help manage weight
Motivation	Strategies to increase the desire to control weight
Planning content	Plan types of food/physical activity in advance of performing behaviour
Scheduling of diet and activity	Plan timing and context/location of food/physical activity in advance of performing behaviour
Regulation: Allowances	Unrestricted consumption of or access to pre-specified foods or behaviours
Regulation: Restrictions	Avoid or restrict pre-specified foods, behaviours, or settings
Regulation: Rule setting	Mandate responses to specific situations
Restraint	Conscious restriction over the amount that is eaten
Reward	Reinforcement of achievement of specific behaviour or outcome through reward contingent on the meeting of that target
Self-monitoring	Record specific behaviours or outcomes on regular basis
Stimulus control	Alter personal environment such that it is more supportive of target behaviours (adapted from CALO-RE)
Support: Buddying	Perform target behaviours with another person
Support: Motivational	Discussing, pledging, or revealing weight loss goals, plans, or achievements or challenges to others to bolster motivation
Support: Professional	Seek help to manage weight from someone with specific expertise
Weight management aids	Use of and/or purchase of aids to achieve weight loss in any other manner (including, but not limited to, reducing energy intake and increasing energy output)

Table 7 Strategies grouped by domain

Strategy	Domain	Cross classification
Adjust the amount you eat in response to how much you have eaten/will eat	Energy compensation	food
Adjust the amount you eat in response to the amount you have exercised/will exercise		food
Adjust the amount you exercise in response to how much you have eaten/will eat		activity
Adjust the amount you exercise in response to how much you have exercised/will exercise		activity
Set food intake targets	Goal setting	food
Set physical activity targets		activity
Set weight targets		
Set one time targets		
Set repeated time targets		
Set achievable targets		
Set body shape/size targets		
Copying the diet behaviour of others	Imitation (modelling)	food
Copying the physical activity behaviour of others		activity
Copying the weight management behaviour of others		
Accept feelings of hunger	Impulse management: acceptance	food
Accept cravings to eat		food
Accept uncomfortable aspects of physical activity		activity
Ask yourself if you are hungry when you find yourself wanting to eat	Impulse management: awareness of motives	food
Ask yourself if you are full when part way through a meal		food
Ask yourself why you feel like not being active		activity
Find other activity to do when you feel like eating	Impulse management: distraction	food
When I'm uncomfortable whilst being active, I do something to distract myself from the sensation		activity
Hold off eating when you have a craving to eat		food
Use physical devices, e.g. gum shield after certain time to discourage further eating		food

Strategy	Domain	Cross classification
Brush teeth to reduce desire to eat	Impulse management: distraction	food
Go to sleep if feeling hungry		food
Seek information on food content/ energy	Information seeking	food
Seek information on calories burned during exercise		activity
Seek information about how to manage weight		
Record your motivation for losing weight	Motivation	
Give yourself visual cue to remind yourself of motivation to lose weight (e.g. fat pictures/ slim pictures)		
Track your progress using chart/graph/body size simulator		
Conscious appraisal of yourself to reinforce your actions (e.g. drawing on self-identity)		
Plan what you are going to eat (at home)	Planning content	food
Bring food for meals when eating away from home		food
Plan what you are going to eat when you are eating out		food
Prepare shopping list in advance		food
Use recipes when cooking		food
Carry healthy snacks for emergencies		food
Incorporate physical activity into commute to work		activity
Find types of physical activity that you enjoy		activity
Create exercise plan		activity
Do more housework/gardening as a way of increasing activity		activity
Allow yourself to eat unlimited amounts of certain foods/ drinks	Regulation: allowances	food
Allowing 'cheat' or 'treat' meals, times or days after restricting for a certain amount of time		food
Allowing physical activity free (or physical activity light) days after doing a certain amount of activity		activity
Avoid certain kinds of food	Regulation: restrictions	food
Don't eat foods you don't particularly like		food
Don't eat foods you like		food
Think in advance about how to politely turn down food		food

Strategy	Domain	Cross classification
Avoid eating in certain settings or at certain times	Regulation: restrictions	food
Avoid certain places where you might purchase food		food
Do not eat out of the packet		food
Go out less		food
Skip meals		food
Don't purchase certain types of food		food
Avoid eating at certain times of day		food
Purchase certain types of food	Regulation: rule setting	food
Leave the table after eating		food
Eat slowly		food
Leave food on the plate		food
Drink large glass of water or tea before meal to try and limit intake by feeling fuller quicker		food
Cut food into small pieces		food
Drink different type of alcohol/swap food for healthier option		food
Maximise potential for physical exertion when being active		activity
Accept some periods will exercise more dietary restraint than others (flexible)	Restraint	food
Rigid dietary restraint		food
Accept some periods will be more rigid about meeting physical activity targets than others		activity
Rigid physical activity restraint		activity
Reward yourself for hitting targets	Reward	
Set aside money at beginning and reward yourself by getting money back if you achieve your targets (contingency contracting)		
Plan when you are going to eat	Scheduling of diet and activity	food
Eat at set times (mealtimes)		food
Schedule doing your food shopping at a time when you are unlikely to be hungry		food
Eat at meal times even when you are not hungry		food

Strategy	Domain	Cross classification
Eat before going food shopping	Scheduling of diet and activity	food
Schedule physical activity		activity
Give up something else to make time for physical activity		activity
Exercise at times/in places where others are least likely to see you		activity
Go to bed at a set time each night		
Measure the content of your food	Self-monitoring	food
Measure the amount of your food		food
Measure the amount of physical activity you do		activity
Monitor your fitness levels		activity
Weigh yourself		
Measure your waist size/other parts of your body		
Monitor tightness of clothes/ rings		
Avoid going into a shop when hungry	Stimulus control	food
Use smaller plates or bowls		food
Choose food packaged in individual portion		food
Do not keep extra food on table		food
Purchase smaller quantities		food
Prepare healthy food in a way that makes it more appealing		food
Store leftovers in portion controlled amounts		food
Order small dish when eating out		food
Keep unhealthy food/drinks out of the house		food
Give yourself cues to increase physical activity		activity
Give yourself cues to stand up/move when stationary		activity
Diet with a friend/family member	Support: buddying	food
Exercise with a friend/family member		physical activity
Get support from a someone you didn't know previously who is also trying to lose weight		

Strategy	Domain	Cross classification
Enhance accountability to buddy	Support: buddying	
Ask people around you not to offer you foods you are trying not to eat	Support: motivational	food
Ask people not to offer you foods you are trying not to eat		food
Attend an exercise group		activity
Get family/friend support		
Get support from people you live with		
Pledge/ agree to contract regarding your weight loss targets		
Commit to your weight loss plans in front of other people		
Seek help to help deal with feeling down, anxious or stressed	Support: professional help	
Belong to a weight loss group		
See healthcare professional about weight loss		
Get support from a dedicated weight loss service or professional		
Use meal replacements to control weight	Weight management aids	food
Purchase/ use home exercise equipment		activity
Purchase gym membership		activity
Purchase/ use equipment to reduce sedentary time in office		activity

2.4.2 Questionnaire

2.4.2.1 *Think aloud interviews*

Think aloud interviews were conducted with 12 participants, with recruitment stopping when saturation was reached. Three men and nine women were interviewed; seven had a university degree, three were 30-39 years old, two were 40-49 years old, and seven were 50-59 years old. All participants had tried to lose weight multiple times.

Think aloud testing led to the removal of some questions and the amending of others. The initial list of 200 questions was reduced to 117 questions, with questions deleted where multiple questions existed for the same strategy. In these instances, the clearest question was chosen based on participant responses (i.e. where participant explanations for the response were in line with the intent of the question). Where all of the questions for a single strategy were understood as intended by the participants, questions were chosen or removed based on participant preferences (for example, one participant commented “the other two [questions about the strategy] were fine, it’s just that one was a bit, I don’t know, I felt it was a bit strange that one.”).

Approximately one third of the remaining questions were amended, mostly relating to specific words. For example, weight *control* was changed to weight *management* throughout after one participant commented that ‘control’ carried negative connotations for her, and suggested switching to management to “put a positive spin onto everything rather than a negative”. Some specific questions were amended to make questions applicable to a broader range of respondents; for example, the question “I have systems at work to remind me to be physically active during the working day (e.g. reminders in my calendar)” was amended to “I have systems to remind me to be physically active

during the day (e.g. reminders on my phone)” as two participants who were asked this question did not work, and therefore did not feel the question was relevant to them, and as one participant did not keep a calendar, so initially answered ‘no’ to this question, though they did use a similar technique. Other questions were amended to improve clarity; for example, “I go to the gym as a way to lose weight” was changed to “I use the gym as part of my weight loss efforts” as one participant struggled to answer the question, explaining:

“I would say yes to that but it would probably be misleading because that’ll not be the only reason I would go to a gym... I would say yes to that but that wouldn’t be specifically that one reason why I would go to the gym.”

Multiple choice response options were also determined during the think aloud phase. Nine of the 12 participants preferred graded response options to yes and no, with the primary reason being that the nature of the strategies leant themselves more easily to levels of gradation. One participant explained:

“It should be more of a scale rather than yes, no... because when you’re talking about like tracking calories and things like that or checking foods in the supermarket, it doesn’t always happen. And I don’t think that many people are so rigid that they do it every single time or every single day.”

Another participant commented:

“I don’t use Lighter Life shakes that often so it’d be nice to sort of say, I wouldn’t use them every day. Use them sometimes and if I particularly really wanted to lose weight to get into a dress, well, I’d use them all the time.”

2.4.2.2 Field testing

During field testing, 167 participants completed the questionnaire at least once and 138 a second time. Participant characteristics are reported in Table 8. Of the 167 participants who answered the first survey, 137 were attempting to lose weight through changes to both their diet and physical activity, three with physical activity only, and 27 by diet only. All participants reporting using at least 22 (19%) of the strategies, with

participants indicating use of 71 strategies on average (SD 17.7). The percentage using each strategy ranged from 7% (contingency contracting) to 92% (self-weighing; setting personal weight loss goals).

Table 8 Participant characteristics: field testing (completed first questionnaire, n = 167)

Characteristic	n (%)
Gender	138 (82.6%) Female
Ethnicity	151 (90.4%) White British/Irish 6 (3.6%) Other White 2 (1.2%) Black British 2 (1.2%) Other Black 2 (1.2%) South Asian 1 (0.6%) Other
Education (highest level completed)	7 (4.2%) No qualifications 57 (34.1%) O/A Level or equivalent 85 (50.9%) University degree 18 (10.8%) Other/no information provided
Age	11 (6.6%) 20-29 years old 25 (15.0%) 30-39 54 (32.3%) 40-49 53 (31.7%) 50-59 21 (12.6%) 60-69 3 (1.8%) 70+
Weight	Mean 96.8 kg (SD 21.0)

The mean kappa score for test-retest reliability across all 117 questions was 0.48 (SD 0.13). The median bias index across all 117 questions was 0.03 (inter quartile range (IQR) 0.015 to 0.06), ranging from 0 to 0.13 and indicating that the bias was low. The median prevalence index was 0.41 (IQR 0.18 to 0.61), ranging from 0 to 0.9. The mean PABAK across all questions was 0.61 (SD 0.15). Five questions had PABAK scores below 0.40 and were reconsidered and rephrased to improve clarity.

An alternative way of assessing test-retest reliability is to use the AC1 statistic.(122) AC1 is a similar measure to PABAK; if the bias index is greater than the prevalence index AC1 and PABAK are equivalent, but in the absence of these conditions (e.g. in this dataset), PABAK is typically more conservative than AC1.(123, 124) A quick

sensitivity analysis using AC1 yields similar values to PABAK, though as expected slightly less conservative – whereas the median PABAK across these results was 0.61, the median AC1 was 0.66. This difference is minimal and would not impact interpretation of the results.

A further 10 questions were rephrased because more than one participant indicated they found the question unclear (seven questions had two ‘unclears’; two questions had three ‘unclears’; one question had four ‘unclears’). No questions were removed. The revised questionnaire can be found in Table 9.

Table 9 Questions in OxFAB, grouped by domain

Note: answer options are: Most of the time; Sometimes; Never or hardly ever; Not relevant to me; Unclear

Question	Domain
I try to balance how much I eat, so if eat a lot at one point I'll make up for it by eating less at other points	Energy compensation
I adjust how much I eat depending on how much physical activity I've done or plan to do	
I adjust how much physical activity I do depending on how much I've eaten or am planning to eat later	
If I haven't been very active, or know I'm going to be inactive for a while, I'll exercise more at another point to balance it out	
I set myself goals for what or how much I'll eat each day or each week	Goals
I set myself goals for how active I'll be each day or each week	
I know how I want to look and won't give up losing weight until I am the size and shape I want to be	
I have a goal weight in mind that I am working towards	
I set goals which may be unrealistic	
I want to achieve my weight loss targets within a set amount of time or by a certain date (e.g. I want to lose weight in time for my holiday)	
I have a clear goal for the amount of weight I want to lose each week	
I've decided to eat some particular foods and/or do certain types of physical activity in my attempt to lose weight because it worked for someone I know	Imitation
When I feel like eating something that doesn't fit with my diet, I acknowledge the feeling but don't act on it	Impulse management: Acceptance
When I feel uncomfortable or am in pain when I'm exercising, I accept it as I know it's doing me good	
If I feel like eating but am trying not to, I pause and ask myself if I'm hungry	Impulse management: Awareness of motives
Part way through eating a meal, I pause and ask myself if I'm full enough to stop	
If I feel like being inactive, I ask myself why I feel that way	
If I feel like eating but am trying not to, I find something else to do to distract myself	Impulse management: Distraction
When I have a craving for something I shouldn't eat, I try to think about something else to take my mind off it	
If I feel like I want to stop exercising, I focus on something else to distract me so that I keep going	
If I feel like eating but am trying not to, I make myself wait a certain amount of time to see if the craving passes	

Question	Domain
If I feel like eating but am trying not to, I chew gum, drink something, or brush my teeth to stop me from doing so	Impulse management: Distraction
I try to go to sleep as a way to not eat when I am feeling hungry	
When I'm grocery shopping and items of food look similar, I make my choice based on the nutritional information on the food labels	Information
I use a book, website or app to look up the nutrition information and/or calorie content of the foods I eat	
I've looked up information on how many calories I burn doing physical activity	
I've looked up strategies, tips or plans for how to lose weight	
I check the nutritional information of the food I choose when eating out	
I use pictures of myself, other people, events, or places to remind me why I want to lose weight	Motivation
I look at clothes that I would like to wear but are currently too small to boost my motivation to lose weight	
I keep a note or a record to remind myself of my reasons for losing weight	
I keep myself motivated by reminding myself of the reasons I want to lose weight	
I use a chart, graph or diary to track my progress in losing weight	
I use an online program or app to look at my body shape and how it could change	
I draw on my values about what is important in life to motivate me to lose weight	
I plan my meals in advance to manage my weight	Planning content
When I'm away from home (e.g. at work), I take food with me so that I can stick to my eating plan	
If I'm going to eat out, I'll plan what I'm going to eat before I get there to help me stick to my diet	
I plan my food shopping in advance to help me stick to my diet (e.g. use a shopping list)	
As part of sticking to my diet, I use particular recipes	
If I'm trying to get somewhere, I'll walk or cycle some or all of the way as a way to help me manage my weight (e.g. cycling to work, walking to the shops instead of driving or taking the bus)	
I follow an exercise plan/routine	
I've taken to doing more chores at home/in the garden to help me get more exercise and lose weight	
I've chosen a type of physical activity I prefer in order to keep it up	

Question	Domain
My diet allows me to I eat as much as I want of certain types of food and drinks	Regulation: Allowances
After I've been dieting for a certain amount of time, I'll allow myself a food treat that isn't part of my diet	
I skip meals as a way to lose weight	Regulation: Restrictions
To help me manage what I eat, I try to avoid eating certain foods	
I try not to eat anywhere but at the table	
Part of my plan to lose weight is to eat only the foods I especially enjoy	
I avoid eating in certain settings or at certain times of day as a way to help me lose weight (e.g. in front of the television, on the go, late at night)	
There are specific shops or aisles in the supermarket that I avoid to help me stick to my diet	
To control how much I have, I put a certain amount of food on a plate or drink in a glass	
I choose not to go out because I am on a diet	
I think ahead about ways to turn down food when people offer it to me (e.g., before going to a party I think of reasons to give for turning down cake)	
I leave the table immediately after I've finished eating as a way to keep me from eating more	
I avoid eating some of my favourite foods because I'm worried if I start eating I may eat too much	
When I go food shopping, I try to only buy the types of food that I know I should be eating	Regulation: Rule setting
I slow down how quickly I eat in an effort to eat less	
I drink water or low calorie/low sugar drinks between alcoholic drinks to limit the amount of calories I consume	
I cut my food into small pieces to help me manage my eating	
I have water or a low-calorie drink or eat low-calorie food to help me eat less during meals	
When I am food shopping, there are certain foods I stay away from to help me stick to my diet	
I would swap one type of food or drink for another if I knew one would be better for my diet (e.g. lower fat or lower sugar versions of foods I normally eat)	
When I'm being active, I push myself to my limits	
I try to leave food on my plate at the end of a meal as a way to eat less	Restraint
I have a weight management plan, but I allow myself to be flexible about what I do depending on circumstances	

Question	Domain
I've designated certain times/days as points where I don't have to stick to my diet, in order to reward me for sticking to it at other points	Reward
I'll reward myself for my sticking to my exercise goals by occasionally having days where I don't do much physical activity	
If I've reached one of my weight loss targets, I will reward myself with something that isn't food	
I put aside money at the beginning of my weight loss attempt and only allow myself to have it back if I've hit my targets	
I plan the times of day when I am going to eat to help me with my weight loss plans	Scheduling
I eat at mealtimes, even if I'm not hungry	
I go to bed at a particular time each night to help me lose weight	
I schedule physical activity into my week	
I give up something else to make time for exercise (e.g. watching TV, socializing, leave work early)	
I try to exercise at times or in places where other people are least likely to see me	
I plan when I am going to do my food shopping to make sure it's not at a time when I am really hungry	
I keep track of the calorie and/or nutritional content of the things I eat	Self-monitoring
I check the portion sizes of the things I eat	
I keep track of the physical activity that I do	
I measure my fitness levels (e.g. heart rate, how long it takes to do certain things, how much weight I can lift)	
I keep track of my weight by weighing myself	
I measure my waist (or other parts of my body)	
I use the tightness of my clothes or rings to keep track of my weight	
If I feel like eating but am trying not to, I avoid going into shops that sell food	Stimulus control
I use smaller plates, bowls or glasses when eating to help with my portion control	
I buy food pre-packaged in individual portions whenever I can	
As a way to keep me from overeating, I serve up food before bringing it to the table	
If I have leftovers, I'll store them in portion controlled amounts to prevent me from eating too much later	
As a way to eat less, I share food when eating out	
I buy smaller amounts of certain foods to help me eat less	

Question	Domain
To help me manage my weight, I order smaller dishes when eating at a restaurant (e.g. a starter or child size dish as a main)	Stimulus control
To avoid eating or drinking things that don't fit with my diet, I don't keep them at home	
I do something to prompt me to exercise (e.g. lay out my exercise clothes the night before)	
I have systems to remind me to be physically active during the day (e.g. reminders on my phone)	
I buy or prepare healthy foods in a way that makes me more likely to eat them (e.g. fruit salad instead of whole fruits, carrot batons instead of whole carrots)	
I am trying to lose weight alongside a friend/family member/my partner	Support: Buddying
I feel like I am part of a team with my friend(s)/partner/family member. We are losing weight together.	
I have an online weight loss buddy	
I exercise in a group and I think it is more enjoyable than exercising alone	Support: Motivational
I exercise in a group and it makes me work harder than I would do on my own	
I've tried to get the people I live with to encourage my weight loss plans	
I've tried to get my friends and family to support me in managing my weight	
I warn people in advance that I am dieting so that they don't offer me foods I am trying not to eat	
I told other people about my weight loss goals to help me stick to them	
I've promised other people I'll lose a certain amount of weight	
I belong to a group of people who are trying to lose weight together (for example, an online discussion forum, a group of colleagues all trying to lose weight)	
I am losing weight with a friend/family member/my partner and I'm trying hard to lose more than them	
I exercise with a group and when I don't attend someone asks me why I wasn't there	
Feeling stressed, down, or anxious can make me break my diet so I sought help to tackle my feelings	Support: Professional
I've talked to a healthcare professional about managing my weight (e.g. doctor, nurse, dietitian, physiotherapist, psychologist)	
I use a weight loss service to help me manage my weight (for example, Weight Watchers, Slimming World, Lighter Life)	
I use meal replacements (e.g. shakes, diet bars, etc.)	Weight management aids
I use the gym as part of my weight loss efforts	
I use something at my desk that helps me stay more active when working (e.g. a standing desk)	
I exercise at home using my own equipment or DVDs	

2.4 Discussion

The OxFAB taxonomy and questionnaire draw upon existing weight management resources, behaviour change theories, and taxonomies. The questionnaire has been tested for face validity and revised where appropriate. Test-retest scores show it provides reliable measures of individual weight control strategies in most cases and further refinements are expected to enhance the reliability further. The taxonomy has been used to code interventions in a systematic review of self-help interventions for weight loss (Chapter 3)(69) and to explore individuals' accounts of weight management through a systematic review of qualitative studies (Chapters 5 and 6). The questionnaire has been used to track the behaviours individuals use in managing their weight as part of an observational cohort study (Chapter 4).

The OxFAB taxonomy is distinct from other behavioural taxonomies due to its focus on the cognitive and behavioural strategies individuals use themselves, as opposed to those used by people delivering behaviour change interventions. However, as would be expected, some elements of the OxFAB taxonomy map onto Michie et al.'s 93-item behaviour change technique taxonomy.(94) For example, in 'action planning' (item 1.4 in Michie et al.'s taxonomy), a therapist may engage with a client to determine where, when, and how a person exercises. However, it is the individual who has to enact this, with various possible strategies. For example, the individual may schedule the activity, making reminders to assist memory. S/he may need to resist the impulses arising from a disinclination to exercise or use 'impulse acceptance,' noticing the impulse but not acting on it. The Michie taxonomy describes the actions of the therapist in this scenario, whereas the OxFAB taxonomy and questionnaire are designed to describe the internal

world of the person receiving the therapy, and the efforts they engage in to fulfil their plan.

There is no agreed methodology for taxonomy development.⁽⁹⁴⁾ Future steps will include further discussions and collaborations with colleagues which may result in changes to the taxonomy, changes to descriptions of elements of the taxonomy, or both, which may in turn result in new questionnaire items after which formal reliability testing will be conducted. Accordingly, at this early stage of development there are several limitations. There are legitimate considerations of completeness; though data saturation was reached in the initial stage of coding self-management resources, and though think aloud interviews did not generate strategies not covered by the questionnaire, there may be some relatively less common strategies that are not currently included. Newly identified strategies can be incorporated in future iterations, as this initial version of the taxonomy is discussed and utilised by colleagues in the field and as the breadth of behavioural interventions expands. Currently, the OxFAB taxonomy and questionnaire deliberately exclude strategies outside of a person's own control and do not include those strategies which would be clinically contraindicated (e.g. purging); their inclusion will hinge on feedback from users. Once a consensus has been reached that the breadth of strategies are adequately captured and that the descriptions domains are adequate to support accurate coding, the test-retest will be repeated and formal inter-coder reliability will be performed.

The OxFAB taxonomy and questionnaire can be used in a variety of ways, some of which are illustrated in this thesis. First, the OxFAB taxonomy can be used to encourage a systematic approach to the description of the cognitive and behavioural strategies advocated as part of interventions for weight management, such that the same strategy is

described in the same terms, facilitating understanding and synthesis of research findings, similar to the way in which existing behaviour change taxonomies are used. Second, the taxonomy can be used to characterise the content of weight management attempts described in the current academic literature (as per the quantitative (Chapter 3) and qualitative (Chapters 5 and 6) systematic reviews conducted as part of this thesis). Thirdly, the questionnaire can be used to help identify the active ingredients of weight management attempts at the level of individual implementation (as tested in the OxFAB cohort study, see Chapter 4). Fourthly, both the taxonomy and questionnaire can be used to relate weight change to these behavioural components (again as tested in the OxFAB cohort study, see Chapter 4). Through these routes the OxFAB taxonomy and questionnaire aim to stimulate the development of new interventions designed to prompt adoption of the most effective strategies.

Chapter 3 Self-help for weight loss in adults with overweight or obesity: systematic review and meta-analyses

3.1 Summary

This chapter presents a systematic review and meta-analyses which set out to determine the effectiveness of self-help interventions for weight loss, to identify their effective components, and to examine their applicability across the spectrum of socioeconomic status. Electronic databases were systematically searched in November 2013 for randomized controlled trials comparing self-help interventions with other self-help interventions or minimal controls in adults with overweight or obesity, with follow-up at six months or longer. The primary outcome was mean difference between intervention and control for six and 12 month change in weight. Data were also extracted on socioeconomic status and interventions were coded using the OxFAB taxonomy (Chapter 2). Twenty-three studies were included, representing 9,632 participants and 39 intervention arms. Self-help interventions led to greater weight loss than unsupported attempts to lose weight at six months (mean difference -1.85 kg, 95% CI -2.86 to -0.83). Interactivity and tailoring were associated with increased effectiveness. Findings were limited by unexplained statistical heterogeneity, few studies with follow-up at a year or longer, insufficient data with which to investigate the relationship between weight change and OxFAB taxonomy domains, and insufficient evidence to reach conclusions on effectiveness in socioeconomically disadvantaged people.

Note: A version of this analysis has been published by the *American Journal of Public Health*.(69)

3.2 Introduction

Though self-directed weight loss accounts for the majority of weight loss attempts (see Chapter 1), we know very little about what goes on in these attempts and indeed what can be done to improve the success of such attempts. One potential option for people attempting to lose weight without professional support is to use self-help interventions to guide their weight management attempt - namely, interventions that are self-directed and do not require professional input to deliver. Such interventions come in a variety of formats, including but not limited to print, internet, and mobile phone delivered programmes. As discussed in Chapter 1, data from the last five years suggest these interventions are being widely used.(85-87) In the recent nationally representative survey of 2000 adults with overweight or obesity from the UK, Denmark, and Portugal who had completed at least one weight loss attempt in the past year, 14% of men and 18% of women had used self-help resources in their most recent weight loss attempt (again, see Chapter 1).(57)

Despite their widespread use, the evidence on the effectiveness of these resources as a whole is lacking, as most reviews of trials of self-help interventions for weight loss are defined by the format of the programmes rather than the content.(125-127) Results from format-specific reviews suggest such interventions may be promising, but results across these reviews are mixed. This format-specific focus, though informative for questions about delivery medium, limits the opportunity to examine the behavioural components across format types, and also leads to the inclusion of some more resource-intensive interventions alongside true 'self-help' programmes (e.g., some internet interventions may include input from trained personnel). In addition, there is limited evidence on the

longer term effectiveness of these interventions, with longer term data frequently only emerging from uncontrolled programme evaluations.(128)

A further challenge in evaluating self-help resources is difficulty in comprehensively coding the behavioural components of such interventions. Existing taxonomies written from the perspective of the interventionist do not necessarily translate onto all potential elements of self-help interventions, which by their very nature do not include interventionists at the point of delivery. The development of the OxFAB taxonomy, as introduced in Chapter 2, therefore created a unique opportunity to comprehensively evaluate the content of existing self-help interventions using a systematic approach.(99)

3.2.1 Self-help interventions across socioeconomic groups

In addition to defining ‘self-help’ and categorising the components of such interventions, a further complication when evaluating the effectiveness of self-help resources is their transferability to both socioeconomically disadvantaged and advantaged populations, as it is possible that the effectiveness could vary by population group.(129) As discussed in Chapter 1, in middle and high income countries, obesity is more common among lower socioeconomic groups. However, there is concern that some interventions tackling obesity are more likely to engage more advantaged groups, thus further widening existing inequalities.(18-20) Of specific relevance to this review, it may be that self-help programmes in particular are more effective for socioeconomically advantaged groups.

There are a number of possible mechanisms through which socioeconomic status may influence the effectiveness of self-help programmes. Executive functioning, a theorised control network regulating behaviours, has been linked with poverty in childhood, with

more disadvantaged groups associated with lower strength of ‘executive functioning’ in adulthood. Weaker executive functioning could conceivably diminish an individual’s ability to enact the recommended actions in self-help programmes, as lower levels of executive functioning have been found to be associated with uncontrolled eating and a lower level of inhibitory control.(24, 25) It has also been theorised that ‘cultural capital’, expressed through certain attitudes, knowledge, and competencies, may increase the ability of more socioeconomically advantaged groups to enact behaviour change to improve health outcomes, whereas the corresponding lack of cultural capital may diminish health-related behaviour change in less advantaged populations.(26) In addition, it may be that the environmental factors which contribute to higher levels of obesity in socioeconomically disadvantaged groups provide further barriers to responding to the recommended actions in self-help programmes, including issues such as access to healthy food and safe and affordable recreation.(22, 23) Accordingly, the provision of self-help materials, which draw on executive functioning and cultural capital in order to affect change in health outcomes, could exacerbate existing health disparities by leading to greater weight loss in more socioeconomically advantaged groups whilst having less of an impact on disadvantaged groups.

3.2.2 Review aims

Framed against the above background, this review set out to:

1. evaluate the effectiveness of self-help interventions for weight loss in adults with overweight or obesity so as to assess the suitability of this approach moving forward;

2. evaluate the strategies used in self-help interventions tested in randomized controlled trials so as to further inform the OxFAB taxonomy and test its use in intervention coding (see Chapter 2);
3. identify the most effective components of these interventions to test the relationship between strategies and other programme components and weight loss success; and
4. examine the applicability of these programmes to less advantaged populations.

3.3 Methods

A review protocol was agreed and published on the PROSPERO database prior to commencing work.⁽¹³⁰⁾ Where relevant, methods followed those set out by Cochrane, detail of which follows.⁽¹³¹⁾

3.3.1 Search

Systematic searches were run of 11 electronic databases in November 2013 (MEDLINE, EMBASE, PsychINFO, Cochrane Database of Systematic Reviews, CENTRAL, CPCI, DARE, HTA, SCI, CINAHL and SPORTDiscus) for randomized controlled trials using terms relating to obesity, weight loss, diet, exercise, behaviour change, self-care, and formats relevant to self-care, including web-based and printed interventions. Terms relating to obesity, weight loss, diet, exercise and behaviour change were adapted from existing reviews.^(67, 68) The Cochrane Highly Sensitive Search Strategies for identifying randomized trials were used to identify randomized controlled trials.⁽¹³¹⁾ Terms relating to self-care and relevant format types were adapted from existing Cochrane reviews of self-help interventions for other conditions (e.g. smoking cessation).^(81, 132-134) The MEDLINE search strategy can be found in

Appendix 1. Studies were also identified through screening reference lists of relevant trial reports and systematic reviews and through contacting authors in the field. Clinical trials registries (ClinicalTrials.gov and the ISRCTN Register) were searched to identify unpublished and ongoing studies.

3.3.2 Inclusion criteria

3.3.2.1 Types of studies

I included randomized controlled trials or quasi-randomized controlled trials, published in English. Studies published as abstracts or conference presentations were included only if sufficient details were available to allow analysis.

3.3.2.2 Participants

To be included studies must have recruited adults (≥ 18 years) with a BMI of ≥ 25 kg/m² (or a BMI of ≥ 23 kg/m² in Asian populations). Studies exclusively in pregnant women or in people with eating disorders were excluded.

3.3.2.3 Interventions

Interventions had to explicitly aim to achieve weight loss through behaviour change. Interventions that involved other lifestyle changes (e.g. smoking cessation) were excluded.

Self-help was defined as interventions that could feasibly be delivered in a self-management context, e.g. used by individuals for a weight loss attempt not assisted by health care professionals, counsellors, or any other kind of person-to-person support. This included, but was not limited to, automated internet interventions, mobile phone applications, and printed material. Interventions involving human input in programme delivery were only included where input was limited to the research component or to

advising a participant on how to use the resource being tested, or where input was brief (one session), judged not to be integral to the intervention or easily able to be automated, and provided to both intervention and control participants. Following methods used in the Cochrane review of self-help interventions for smoking cessation, leaflets limited to general health information were not included as interventions, but were considered as a control if compared with more substantial self-help materials.(132)

3.3.2.4 Comparators/control

To be included, studies were required to have a control group, defined as either receiving no self-help material or receiving self-help material that differed based on format or self-management strategies advised. Brief leaflets on the health effects of obesity were not included as interventions, but were considered to be a control if compared to more substantial self-help materials.

3.3.2.5 Outcomes

To be included, studies were required to measure weight change at six months or longer.

3.3.3 Data collection and assessment

I screened all titles and abstracts, with a sample of 10% checked by a second reviewer, using a pre-defined inclusion/exclusion worksheet. Data were extracted independently by two reviewers (myself and a second reviewer) using a pre-piloted data extraction form, with discrepancies resolved by discussion. If further detail were required on study design or outcome, I contacted authors for further information and sought related publications and trial protocols. Data were extracted on:

- Recruitment methods

- Study population: number of participants randomized; age; BMI; weight; gender; race
- Setting (country)
- Intervention characteristics: format (internet, app, printed, podcast, etc.); interactive/non-interactive; tailored/non-tailored; self-management strategies as per the OxFAB taxonomy (see Chapter 2); diet and physical activity prescriptions; nature of person-to-person contact (if any)
- Control/comparator group details (as per intervention details)
- Outcome: number of participants followed-up; weight change at all available time points; changes in behavioural processes
- Socioeconomic variables: education; income; deprivation indexes; any reported analyses comparing effects by socioeconomic status.

3.3.3.1 Risk of bias assessments

The second reviewer and I independently assessed each study for risk of bias based on criteria developed by Cochrane.⁽¹³¹⁾ Studies were judged to be at low, high, or unclear risk of bias based on random sequence generation and allocation concealment (selection bias), detection bias, attrition, and other risk of bias. Unclear was used where there was insufficient information to make a judgement of low or high risk.

For some domains, the approach taken to assessing risk of bias had to be adapted to reflect the behavioural nature of the interventions being tested. The domains in the standard Cochrane risk of bias tool are of direct relevance to randomized controlled trials of pharmaceutical interventions, but as blinding of participants is often unfeasible in trials of behavioural interventions, the approach to assessing performance and detection bias had to be tailored to reflect the types of interventions being assessed in

this review. Performance bias refers to participants' awareness of the intervention to which they are allocated, and the nature of the interventions included in this review precluded that type of blinding. As a result, performance bias was not included as a bias domain for this review. Blinding was assessed as it related to risk of detection bias and was evaluated based on the method of outcome measurement used: if the method was objective (e.g. in-person weighing by a member of research staff blinded to participant allocation), the study was judged to be at low risk of detection bias, whereas if the method was subjective (e.g. self-report), the study was judged to be at high risk in this domain. Another consideration was the nature of the control intervention, with some studies opting to offer participants in the control group the intervention after the end of the study (wait list controls). Studies which employed wait list controls were judged to be at high risk of other bias if participants in the control arm knew they had been placed on a wait list, as this could potentially delay initiation of a weight loss attempt.

A further challenge to assessing risk of bias in this group of trials is attrition, which is a substantial challenge in weight loss trials, with many trials reporting loss to follow-up of 30% or more at one year.⁽¹³⁵⁾ In the absence of validated criteria with which to judge risk of attrition bias in weight loss trials, studies were considered to be at high risk of attrition bias where fewer than 50% of the sample was followed up at six months or where follow-up rates differed by greater than 20% between groups at six months, an approach used in previous reviews of weight loss interventions.⁽⁶⁶⁾ I had planned to assess risk of publication bias using funnel plots, but was unable to do so due to insufficient data.

3.3.3.2 Coding intervention content

Alongside data extraction, two reviewers (myself and a second reviewer) independently coded each intervention against the domains of the OxFAB taxonomy (see Chapter 2).⁽⁹⁹⁾ We followed an approach used previously to code intervention content against taxonomies of behaviour change techniques (BCTs) delivered by interventionists.^(68, 73, 136) Each intervention was coded as yes, no, or unclear for use of strategies in each domain, with verbatim text copied from the papers, protocols, or original intervention materials (where available) to provide explanation for the code. Unclear was used where the strategy was implied but not explicitly stated. Rather than coding against BCTs, however, we coded against OxFAB domains (see Chapter 2) as many BCTs are not relevant to self-help interventions.

A second reviewer and I also extracted detail on other programme characteristics, including whether the intervention was tailored and/or interactive. Tailored interventions were defined as those where participant characteristics were used to provide individualized content (for example, tailored based on information provided by participants at baseline), and defined interactive interventions as those programmes in which participants could actively engage with intervention content (for example, through online quizzes or entering their own content).

3.3.3.3 Outcome measures and dealing with missing data

The primary outcome was mean difference in weight change in kg between study arms at six months, calculated using baseline observation carried forward (BOCF) to facilitate comparisons between studies. BOCF is an intention-to-treat analysis which imputes baseline weight for participants missing at follow-up. Secondary outcomes included changes in behavioural processes and weight change at 12 months and longer.

Careful consideration went into deciding to use BOCF analyses for the primary outcome. As mentioned previously, attrition is often substantial in weight loss trials.(135) This poses a challenge as there is no consistent method for reporting results in weight loss trials, and the choice of imputation method or the choice not to impute missing data in each trial affects the apparent rate of regain, introducing spurious variability into the results when comparing outcomes across studies. Robust systematic reviews therefore need to apply a consistent method of analysing data. Without access to individual patient data from all studies, there are two possible approaches to take: using complete case data only (which risks biasing results towards more significant weight loss than was actually present because people who volunteer to be weighed are likely to have done better than those who decline) or imputing data using BOCF. BOCF was chosen for the primary analyses as the more conservative of the two approaches, but I also tested the sensitivity of the results to using BOCF versus complete case data.

Where BOCF data were not presented in the paper, complete case data (and in one case, last observation carried forward (LOCF) data) were used to calculate BOCF, using a previously established method.(137) In all cases, authors were contacted for missing data. Where weight change data were not available in any of these forms, I report results narratively in the text. Where available, intermediate outcome data related to the behavioural processes covered by the OxFAB taxonomy domains were also extracted.

3.3.4 Statistical analysis

I pooled studies where self-help interventions were compared with a minimal control and studies which compared self-help interventions with respect to a variable of interest. Meta-analyses were conducted using a random effects model in Review Manager 5.2.(138) I conducted separate analyses for weight change at 6 and 12 months. Pooled

results were presented as mean differences (kg) with 95% CI. The I^2 statistic was used to present statistical heterogeneity between studies.(139) Generally, values between 30 and 60% are viewed as indicating moderate heterogeneity and values between 50 and 90% are viewed as an indication of substantial heterogeneity.(131) I conducted sensitivity analyses to test if effect sizes differed when excluding studies at high risk of bias or if they differed when using complete case data as opposed to BOCF. I had originally planned to supplement the meta-analyses with meta-regression to explore associations between intervention characteristics and weight change, and associations between the degree to which participants enacted specific behavioural processes and weight change, but did not have sufficient data with which to do so.

3.4 Results

After removing duplicates, the search retrieved 3,883 references, 3,697 of which were excluded at title/abstract stage. One hundred and eighty-six full text articles were assessed for eligibility, with 143 subsequently excluded. The most common reason for exclusion was that the self-help intervention was confounded by an additional, person-delivered intervention (for example: studies which included multiple face-to-face counselling sessions that were only offered to the intervention arm, who were then also given a self-help intervention; studies where the 'self-help' intervention included regular contact with a weight loss counsellor, e.g. through phone or web-based counselling). Other reasons for exclusion are listed in the PRISMA diagram (see Figure 4). I included 43 references, representing 23 studies, 18 of which had sufficient data to be included in statistical analyses (see Table 10). Twelve studies compared self-help interventions with minimal controls (no additional contact with or without printed information on consequences of obesity), seven compared tailored or interactive

programmes with fixed (non-tailored, non-interactive) programmes, and two compared tailored and interactive programmes with non-tailored interactive programmes.

3.4.1 Characteristics of included studies

Characteristics of the included studies are summarized below, covering participants, intervention format and content, and risk of bias. Table 10 provides further detail on the participants and interventions in individual studies.

3.4.1.1 Participants

In total, relevant study arms represented 9,672 participants, with study samples ranging from 33 to 2,862 participants and a mean of 420 participants per study. Twelve studies were conducted in the USA, four were conducted in Australia, three each were conducted in Japan and the UK, and one was conducted in Finland. The mean age of study participants ranged from 36 to 60 years and the majority were female (61% average). Four studies recruited men only (140-143) and one recruited women only.(144) Mean BMI at baseline ranged from 26.2 (Japanese studies) to 36.0 kg/m², with an average of 31.8 kg/m².

3.4.1.2 Interventions

Overall, the included studies represented 39 intervention arms. Figure 5 shows the formats used across interventions; the majority included print materials and the most common form of self-monitoring equipment used was pedometers. Figure 6 categorises the dietary and physical activity recommendations provided to participants; unfortunately, in many cases detail on these were unavailable. Eighteen interventions were both tailored and interactive, six were interactive but not tailored, three were tailored but not interactive (e.g. print materials tailored using baseline data), and 12

were neither tailored nor interactive (i.e. the same content would be viewed or heard by all participants, referred to from hereon in as ‘fixed’). Where access to the intervention was limited (e.g. non-print interventions), length of access ranged from 2 to 12 months. Some programmes also specified the frequency with which participants accessed the intervention content (for example, recommending participants access a programme once a week). Where such recommendations were made, this ranged from daily to four times over three months. In two studies, intervention material could only be accessed at specified sites.(145, 146) In all other studies, interventions could be accessed at the participants’ discretion. Eight studies identified social cognitive theory as the theoretical basis for their intervention, three were designed using the transtheoretical model, two reported employing ‘cognitive behavioural theory’ (the theory behind cognitive behavioural therapy), and one reported using habit formation theory and the behavioural determinants model (the latter is not widely recognised as a model; the authors cite a 1990 review of determinants of exercise behaviour to offer further context).(142, 147) Eleven studies did not state the theoretical basis for their interventions.

Based on domains from the OxFAB taxonomy, the most commonly recommended self-management strategies were goal setting (32 of 39 interventions), self-monitoring (36 of 39), and seeking social support from non-professionals (19 of 39). Fourteen interventions recommended restrictions, and 11 each recommended strategies to boost motivation, strategies to reward oneself for hitting targets, and strategies involving conscious ‘energy compensation’ (most commonly offsetting energy intake by increasing energy output). Figure 7 shows the number of interventions employing each group of strategies.

Figure 4 PRISMA flow diagram

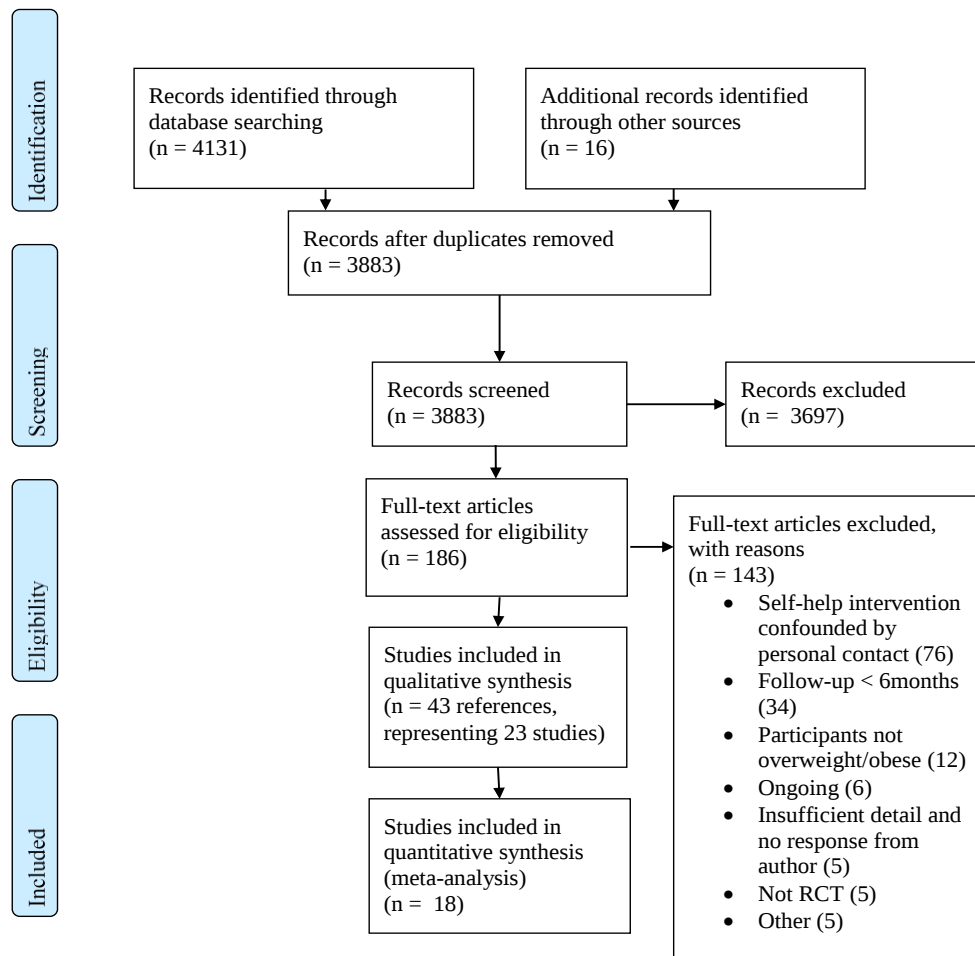


Figure 5 Formats employed in included interventions

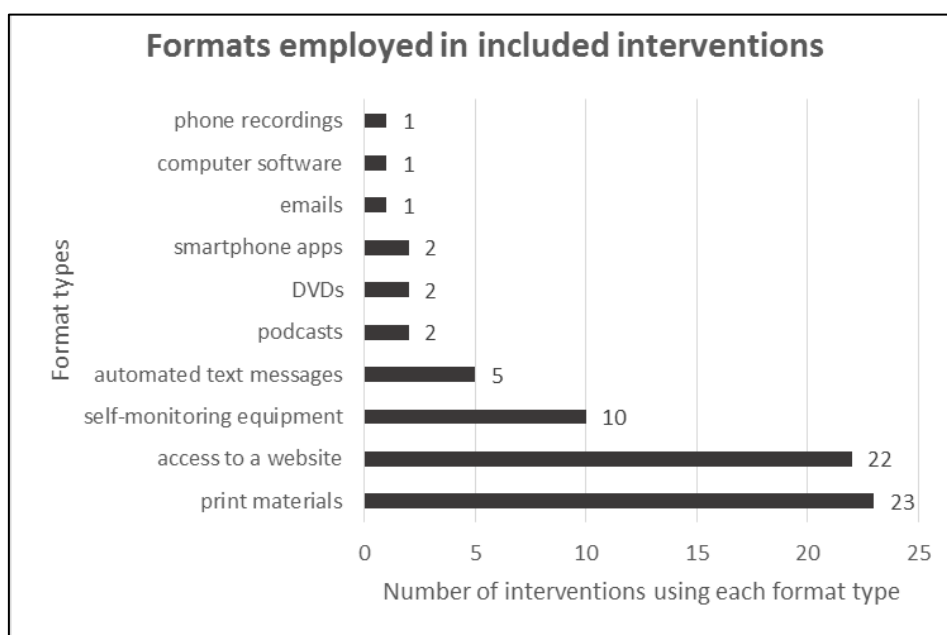


Figure 6 Dietary and physical activity recommendations in included studies

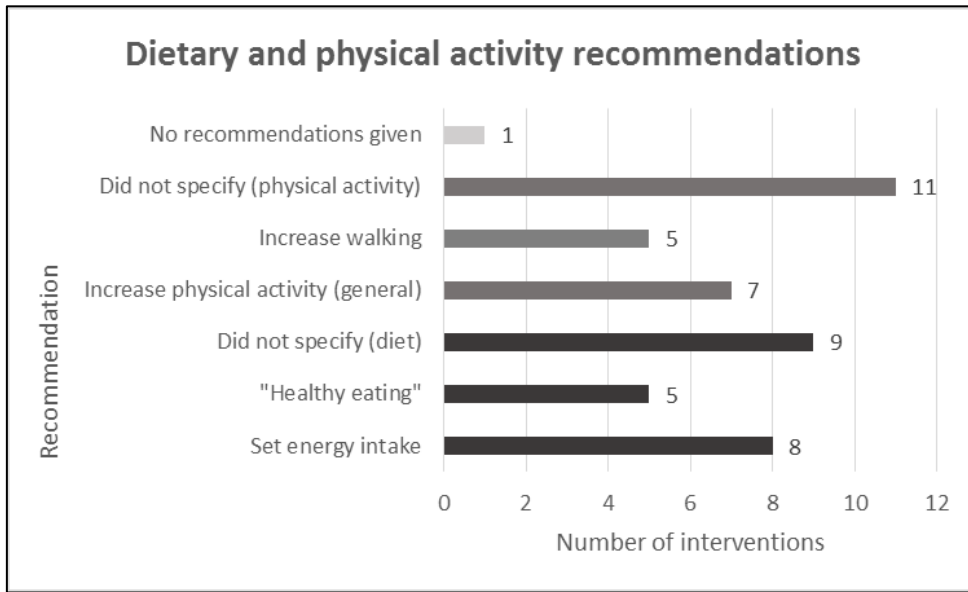


Figure 7 Frequency of use of recommended strategies (by domain) in included studies

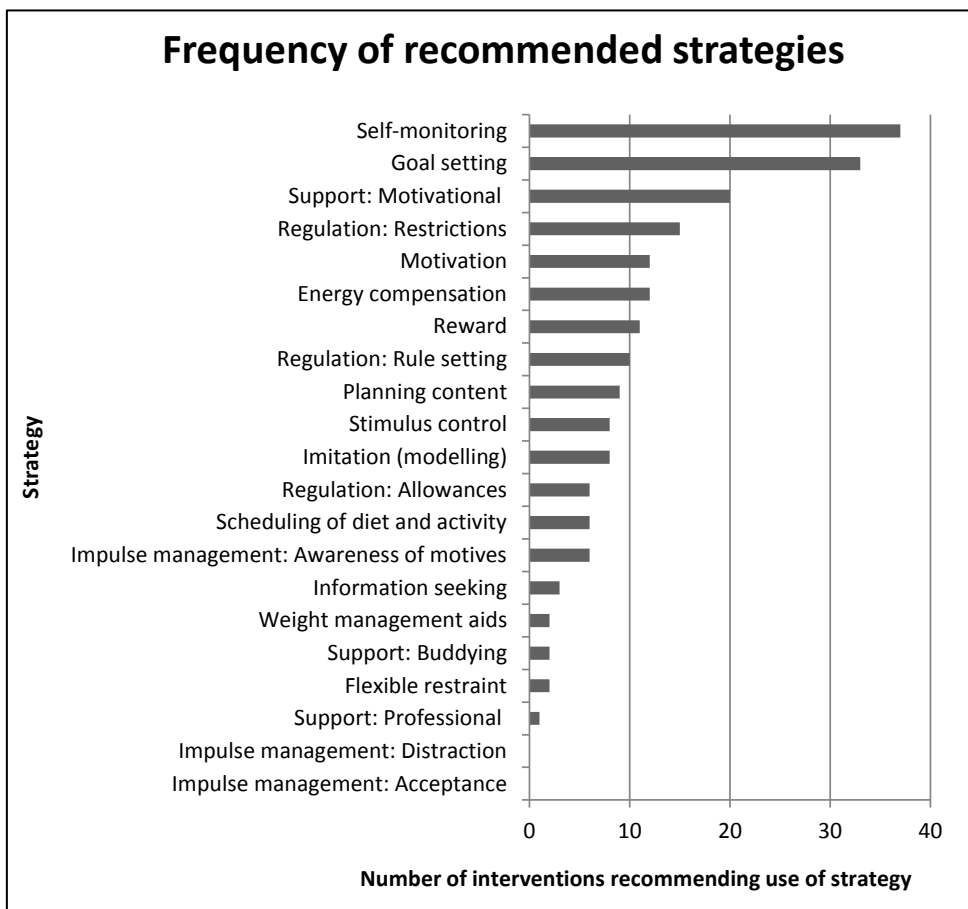


Table 10 Characteristics of included studies³

Study ID, country, n ⁴	Study arms for this review ⁵	Outcomes relevant to this review	Length and frequency of access ⁶	Any personal contact?	Notes
Adachi 2007(144) Japan n = 205	1. Tailored and interactive (print - booklet and letters, pedometer) 2. Fixed (print - booklet and letters) 3. Interactive not tailored (print - booklet, pedometer) 4. Fixed (booklet)	Weight, eating behaviour, restrictions at 7m	1m, but have booklet indefinitely Frequency NS	No	Arm 3 not included in any comparisons. 7m data used in place of 6m data.
Beeken 2013(148) UK n = 527	1. Fixed (print leaflet) 2. Minimal control	None reported	Instructed to use daily over 3m	30 minutes talking patients through study manual using defined script	Data from conference presentation. Results at 6m not available at time of analysis (now available)(149).
Byrne 2006(150) Australia n = 74	1. Tailored and interactive (computerized watch with in-built programme, heart rate transmitter belt, print materials) 2. Minimal control	Weight at 6m	Length NS Frequency: Daily	Session with standard advice as per control group, training and told to email research staff with technical problems	
Carter 2013(151) UK n = 128	1. Tailored and interactive (smartphone app, SMS, web) 2. Interactive (tailored unclear) (web) 3. Fixed non-tailored (print - book)	Weight and self-monitoring at 6m	Length 6m Daily for first week, then users' choice	No	Additional intervention data from YouTube videos

³ m = month(s); NS = not specified; SMS = short message service (text messages to mobile phones)

⁴ n is total of only those participants relevant to this review (excludes additional arms testing more intensive interventions)

⁵ Fixed are programmes which are neither tailored nor interactive

⁶ As recommended by study

Study ID, country, n⁴	Study arms for this review⁵	Outcomes relevant to this review	Length and frequency of access⁶	Any personal contact?	Notes
Collins 2013(152) Australia n = 301	1. Tailored and interactive (web) 2. Tailored and interactive (as per 1 plus automated personalized reports, feedback, web and SMS reminders)	Weight and cognitive restraint scale at 6m	6m, 4 days/week	Phone prompts if didn't enter weight and didn't respond to other prompts	
Greene 2013(153) USA; n = 349	1. Interactive non tailored (web, print, accelerometer) 2. Minimal control	Weight at 6m	NS	No	Authors provided additional outcome data
Haapala 2009(154) Finland n = 125	1. Interactive tailored (SMS, web) 2. Minimal control	Weight and information seeking at 12m	NS	No	
Hersey 2012(155) USA; n = 1177	1. Interactive tailored (web, print) 2. Fixed (web, print)	Weight at 6 and 12m	Length NS Automated weekly feedback	No	
Jeffery 1982(156) USA n = 33	1. Fixed (print) 2. Fixed (print plus contract) 3. Fixed (print plus contract plus phone recording)	None reported	1.5m, weekly in groups 1 and 2, daily in group 3	No	Weight loss at 8m measured but not reported– no usable data.
Johnson 2008(157) USA; n = 1277	1. Tailored non-interactive (print reports and manual) 2. Minimal	None reported	9m, 4 reports at 3m intervals	No	Weight measured but not reported
McConnon 2007(158) UK; n = 221	1. Tailored interactive (web) 2. Minimal control	Weight at 6 and 12m	12m, minimum weekly frequency	Brief instruction on how to use website	Authors provided additional outcome data
Morgan 2011(141) Australia n = 65	1. Tailored interactive (web) 2. Minimal control	Weight at 6 and 12m	3m, frequency NS	One information session as per control	Some therapist contact but intervention primarily automated

Study ID, country, n⁴	Study arms for this review⁵	Outcomes relevant to this review	Length and frequency of access⁶	Any personal contact?	Notes
Morgan 2013(140) Australia n = 159	1. Tailored interactive (web, DVD, pedometer) 2. Fixed (DVD, pedometer) 3. Minimal control	Weight, portion size and alcohol at 6m	3m, 4 days/week	None in 2. In 1, individualized feedback sheets using standardized set of feedback.	
Nakata 2011(159) Japan n = 125	1. Tailored non-interactive (print and pedometer) 2. Minimal control	Weight at 6m	NS, but record weight daily	Motivational lecture prior to assignment. 2 hour group session providing materials	Authors provided additional outcome data
Patrick 2011(142) USA n = 441	1. Tailored interactive (web, pedometer) 2. Minimal control	Weight at 12m, fibre, fruit and vegetables, saturated fat intake at 6 & 12m	NS but presumably 12m, weekly homework	Orientation face-to-face; could email study staff with questions that would be publicly posted on study website	Weight at 6m measured but not reported in useable form for meta-analysis
Rothert 2006(160) USA n = 2862	1. Tailored interactive (web with tailored action plans) 2. Tailored non-interactive (web)	Weight at 6m	2m in arm 1. NS in arm 2. Frequency NS	No	
Shapiro 2012(161) USA n = 170	1. Tailored interactive (web, SMS) 2. Minimal (info only)	Weight at 6 and 12m	12m, SMS 4x/day, newsletters monthly	No	LOCF data only, used to calculate BOCF
Shuger 2011(162) USA n = 99	1. Interactive non-tailored (print, monitoring armband with wrist watch display, web) 2. Fixed (print)	Weight at 9m	4m, armband 16 hour/day and upload info daily	Brief health education session, equipment training and troubleshooting	9m data used in place of 6m data. Additional outcome data received from authors.

Study ID, country, n⁴	Study arms for this review⁵	Outcomes relevant to this review	Length and frequency of access⁶	Any personal contact?	Notes
Tanaka 2010(143) Japan n = 51	1. Tailored interactive (print - booklet and letters, pedometer) 2. Fixed non-tailored (booklet)	Weight at 7m, eating between meals at 3m	Recommend 1m (have indefinitely); frequency NS	No	7m data used in place of 6m data. Additional outcome data received from authors.
Tate 2006(163) USA n = 128	1. Tailored interactive (web, email) 2. Interactive non-tailored (web)	Weight at 6m	6m, frequency NS but weekly reporting in arm 1	Instructions on how to use website following standard script	
Turner-McGrievy 2011(164) USA; n = 96	1. Interactive non-tailored (podcasts, print, app, twitter) 2. Fixed (podcasts, print)	Weight, social support, self-monitoring at 6m	6m, podcasts 2x/week, group 1 asked to log onto twitter daily	In group 1, study coordinator sent 2 messages per day to twitter groups (not individualized)	Additional outcome data provided by author. Low level of app and twitter use in intervention group.
Winett 2007(145) USA n = 707	1. Interactive tailored (web) 2. Minimal	Fibre, fruit, vegetable, fat, planning & tracking, social support at 12m	3m, weekly frequency	Unclear	Cluster randomized, analysis via ITT using generalized mixed model modelling. Material can only be accessed in church.
Wylie-Rosett 2001(146) USA; n = 352	1. Interactive tailored (computer software, print) 2. Interactive tailored (print)	Weight at 12m	12m, weekly for first 3m, monthly after	No	Computer material can only be accessed in foyer of medical practice (group 1).

3.4.1.3 Risk of bias

Only three studies were judged to be at low risk of bias across all domains assessed.(141, 159, 165) Eight studies were judged to be at high risk of bias in at least one domain, and the remainder were judged to be at unclear risk of bias in at least one domain, most commonly due to lack of detail in the reporting of methods of random sequence generation and allocation concealment (16 studies). With the exception of one study using self-report (high risk)(142) and one study where the method of outcome assessment was unclear (unclear risk)(144), all included studies measured weight objectively and hence were judged to be at low risk of detection bias. Three studies were judged to be at high risk of attrition bias (two in which $\leq 50\%$ of participants were followed up at six months (156, 160) and one in which attrition was differential between groups (93% versus 53%)(151)). Two which did not report the number followed up at six months were judged to be at unclear risk of attrition bias.(148, 153)

Three studies were judged to be at high risk of other bias due to use of a wait-list control (140, 145, 161) and a further three were judged at unclear risk as participants were offered the intervention at study end, but it was not clear if they knew they would be offered the intervention in advance.(142, 144, 150) An additional study was judged to be at high risk of other bias as a participant in the control group used a weight loss app and lost 32 kg, which the authors stated had a strong influence on the mean weight loss in the control group.(151) Another was judged to be at high risk of other bias as the intervention arm was followed up at three month intervals whereas the control arm was only followed up at 12 months.(154) Table 11 contains risk of bias judgements for each included study across all domains, along with reasons for each 'high risk' judgement and any judgement in the 'other' category.

Table 11 Risk of bias assessments for included studies

Study ID	Random sequence generation	Allocation concealment	Blinding of outcome assessment	Attrition	Other (optional)	Reason for high risk of bias judgement and judgements in 'other' category
Adachi 2007(144)	Unclear	Unclear	Unclear	Low	Unclear	Control groups given intervention at study end – unclear if wait list
Beeken 2013(148)	Low	Low	Low	Unclear		
Byrne 2006(150)	Unclear	Unclear	Low	Low	Unclear	Wording implies that some participants were unwilling to be assigned to control condition and therefore there are fewer participants in that group
Carter 2013(151)	Low	Unclear	Low	High	High	Uneven dropout (93% followed up in smartphone compared to 55% website and 53% diary). Participant in control group downloaded commercially available MyFitnessPal and lost 32 kg; "had a strong influence on the mean weight change seen in the diary group."
Collins 2013(152)	Unclear	Low	Low	Low		
Greene 2013(153)	Unclear	Unclear	Low	Unclear		
Haapala 2009(154)	Unclear	Low	Low	Low	High	Intervention arm followed up at 3 month intervals, control only followed up at 12 months
Hersey 2012(155)	Unclear	Unclear	Low	Low		
Jeffery 1982(156)	Unclear	Unclear	Low	High		Only 8 of 40 subjects were available for follow-up at six months or longer; only short term results were reported.
Johnson 2008(157)	Unclear	Unclear	Low	Low		
McConnon 2007(158)	Low	Low	Low	Low		
Morgan 2011(141)	Low	Low	Low	Low		

Study ID	Random sequence generation	Allocation concealment	Blinding of outcome assessment	Attrition	Other (optional)	Reason for high risk of bias judgement and judgements in 'other' category
Morgan 2013(140)	Low	Low	Low	Low	High	Wait list control
Nakata 2011(159)	Low	Low	Low	Low		
Patrick 2011(142)	Low	Low	High	Low	Unclear	6 month outcomes self-report only. Control groups given intervention at study end – unclear if wait list.
Rothert 2006(160)	Unclear	Unclear	Low	High		20% of participants followed up at six months.
Shapiro 2012(161)	Low	Low	Low	Low	High	Wait list control
Shuger 2011(162)	Low	Unclear	Low	Low		
Tanaka 2010(143)	Unclear	Unclear	Low	Low		
Tate 2006(163)	Low	Unclear	Low	Low		
Turner-McGrievy 2011(164)	Low	Unclear	Low	Low		
Winett 2007(145)	Unclear	Unclear	Low	Low	High	Wait list control
Wylie-Rosett 2001(146)	Unclear	Unclear	Low	Low		

3.4.2 Weight change

3.4.2.1 Interventions versus controls

Pooled results of studies comparing self-help interventions with controls detected a significant effect in favour of the intervention at six months (mean difference -1.85 kg, 95% CI -2.86 to -0.83). However, statistical heterogeneity was substantial ($I^2 = 76\%$) and was not explained by subgroup differences between tailored/interactive versus fixed programmes; all subgroups detected significant effects in favour of the intervention with no evidence of a difference between subgroups (Figure 8). Sensitivity analysis using complete case data yielded similar results (Figure 9) and the effect estimate remained similar when excluding studies at high risk of bias (mean difference -1.42 kg, 95% CI -2.57 to -0.28).

At 12 months a significant effect was not detected in pooled results from the five studies with data at this point (all tailored and interactive programmes) (mean difference -0.76 kg, 95% CI -1.73 to +0.20, Figure 10), with substantial statistical heterogeneity ($I^2 = 62\%$). Results were heavily influenced by the one study which was at high risk of bias (judged to be at high risk of attrition bias for 12-month data as 49% of intervention participants versus 70% control participants were followed up at 12 months); removing this study from the analysis reduced heterogeneity to low and yielded a significant effect in favour of the intervention (mean difference -1.10 kg, 95% CI -1.97 to -0.23, $I^2 = 38\%$). Very few studies in this analysis reported complete case data, hence a sensitivity analysis was not conducted on this variable.

Figure 8 Self-help interventions versus minimal controls, BOCF weight change at six months

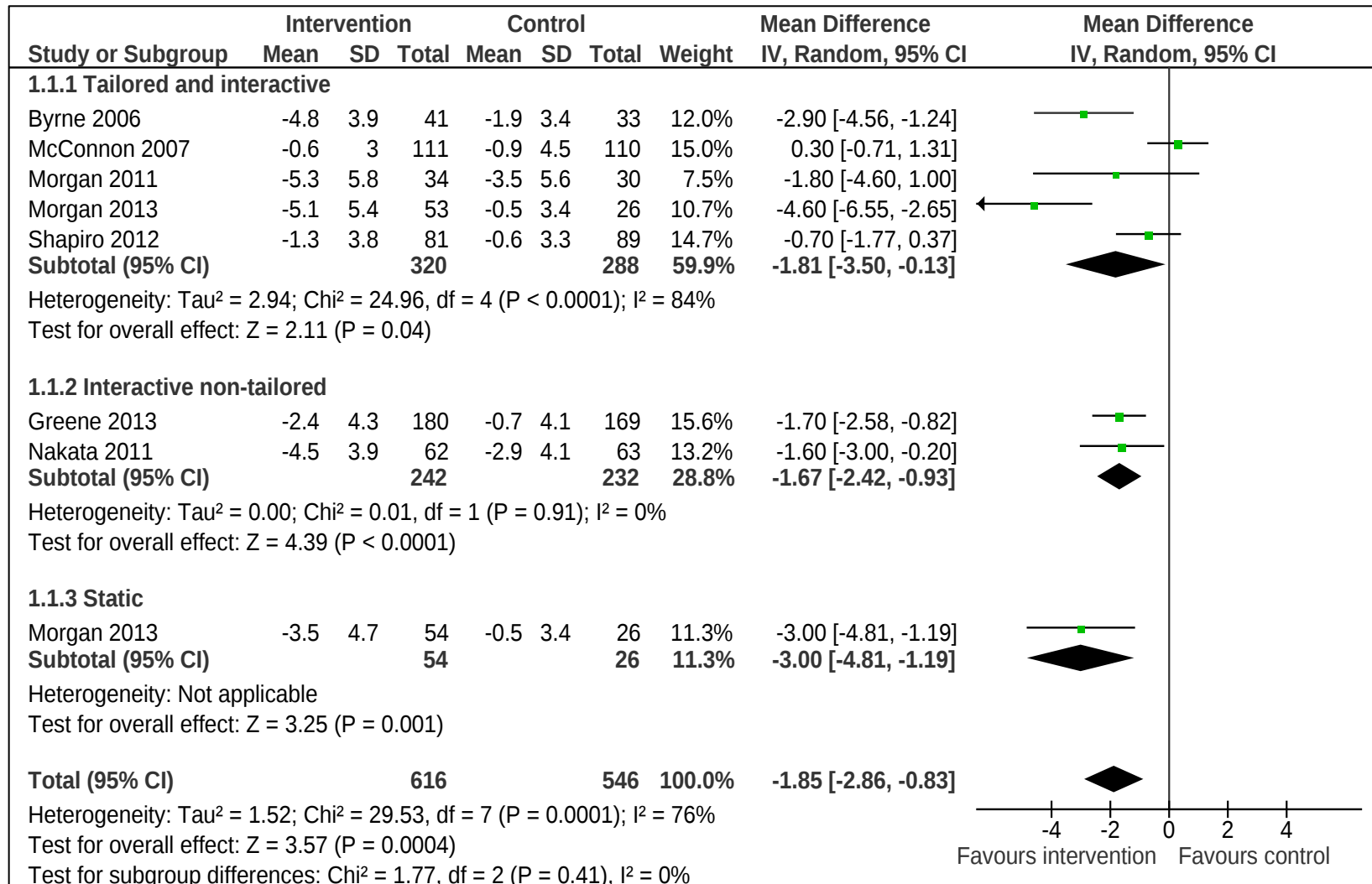


Figure 9 Self-help interventions versus minimal controls, complete case weight change at six months

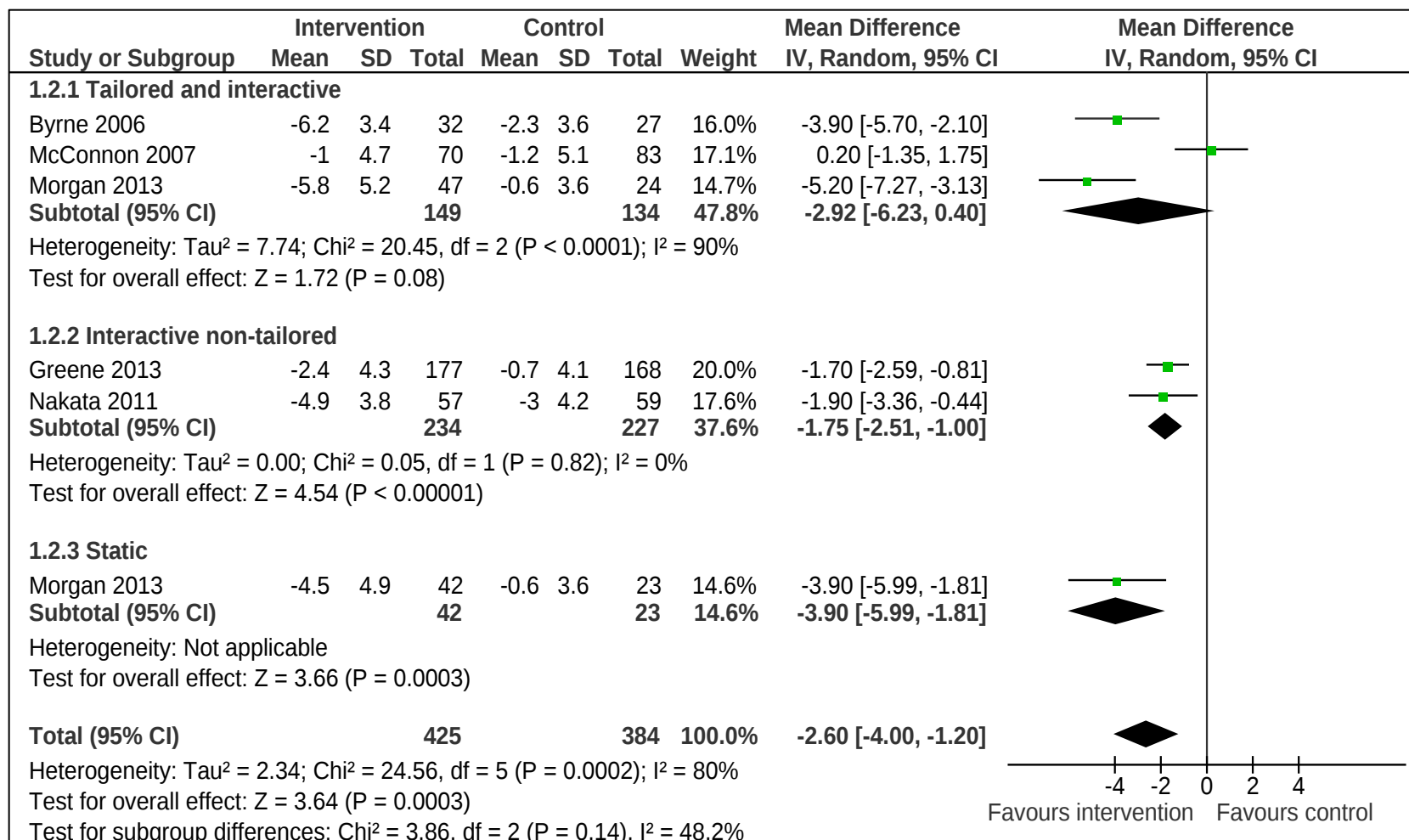
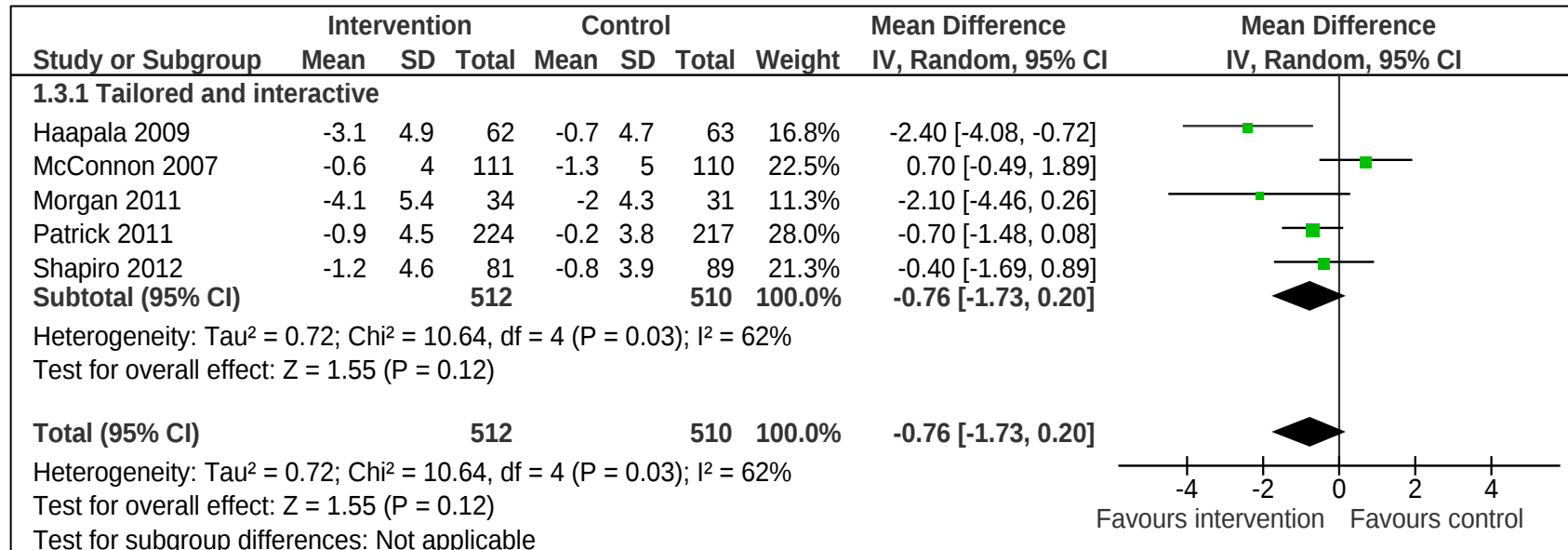


Figure 10 Self-help interventions versus minimal controls, BOCF weight change at 12 months



Three further studies, not included in any meta-analyses, also compared self-help interventions with minimal controls. One study of a tailored and interactive intervention did not publish data on weight change, but reported that the intervention significantly increased healthy eating and exercise behaviours.(157) A second study was not included because it was a cluster randomised trial of a church-based intervention. Participants in the intervention group lost an adjusted average of 0.2 kg (SD 0.4) at seven months, whereas control participants had gained 0.1 kg (SD 0.5).(145) In the third study, comparing a print leaflet with a minimal control, six month data, though collected, were not available at the time of writing. Unpublished data from three month follow-up detected a significant effect of the intervention.(166)

3.4.2.2 Comparisons based on intervention type

3.4.2.2.1 Interactive versus fixed

Results from seven studies directly comparing interactive (with and without tailoring) with fixed interventions detected a significant effect in favour of the interactive programmes (mean difference -0.94 kg, 95% CI -1.50 to -0.38, $I^2 = 2\%$). In subgroup analysis, the significant effect remained in the group of tailored and interactive studies but the pooled effect was not significant in two studies of interactive non-tailored programmes (Figure 11). A sensitivity analysis using complete case data revealed similar results (Figure 12) and results continued to significantly favour the interactive programmes when studies at high risk of bias were removed (mean difference -0.83 kg, 95% CI -1.53 to -0.14). In the one study which reported 12 month data, a significant effect remained (mean difference -0.70, 95% CI -1.37 to -0.03).(155)

3.4.2.2.2 Tailored and interactive versus interactive only

Two studies directly compared tailored and interactive programmes with non-tailored but interactive programmes; pooled results detected a small but significant effect in favour of tailored programmes (mean difference -0.41 kg, 95% CI -0.61 to -0.20, $I^2 = 0$, $n = 2,990$). However, the large majority of participants in this comparison came from one study that suffered very high loss to follow-up, limiting confidence in this finding.(160)

3.4.2.2.3 Addition of specific features

Four studies tested the addition of adjuncts to self-help interventions, but only one detected a significant impact. In the first study, participants who received an expert software programme written to guide them through a tailored workbook lost significantly more weight than those using the workbook only (mean difference -0.80 kg, 95% CI -0.98 to -0.62, $n = 352$, data at 12 months).(146) The second study added a pedometer to both a fixed and a tailored and interactive programme; pooled results comparing arms with pedometers with those not providing pedometers revealed a non-significant mean difference of -0.27 kg (95% CI -0.93 to +0.40, $I^2 = 0\%$, $n = 205$). (144) The third study compared standard with enhanced versions of a web intervention. The enhanced version included the addition of personalized reports and an escalating reminder schedule to use the programme website; a significant difference was not detected between arms at six months (mean difference -0.90 kg, 95% CI -2.12 to 0.32, $n = 301$). (152) The fourth tested the addition of a weight loss contract and/or automated voicemail messages to a mail-based programme.(156) At eight weeks, mean weight loss in the contract and voicemail arms was less than that in the mail only arm, but due to high levels of dropout longer term effects were not reported.

Figure 11 Interactive and tailored programmes compared with fixed programmes, BOCF weight change at six months

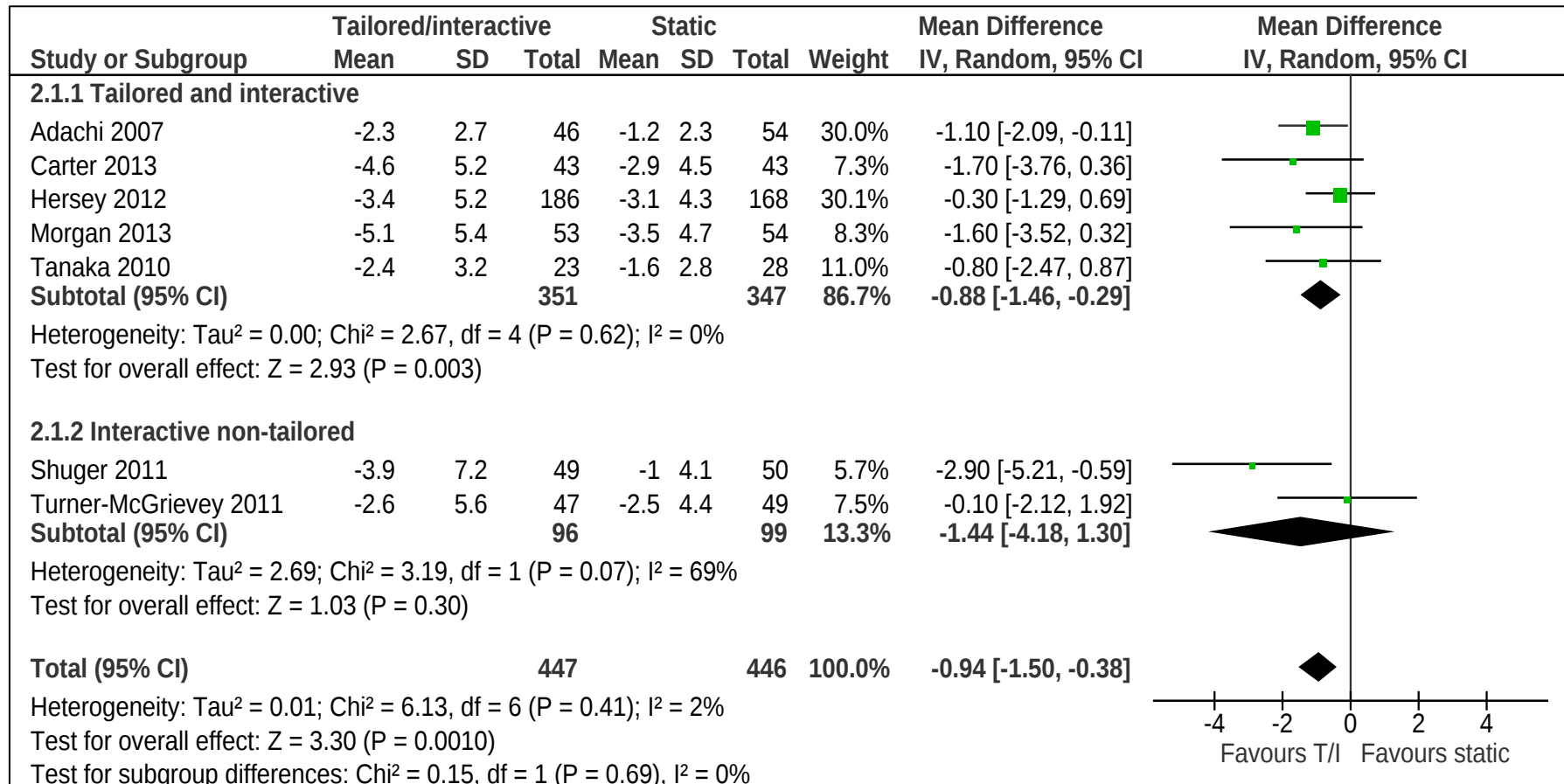
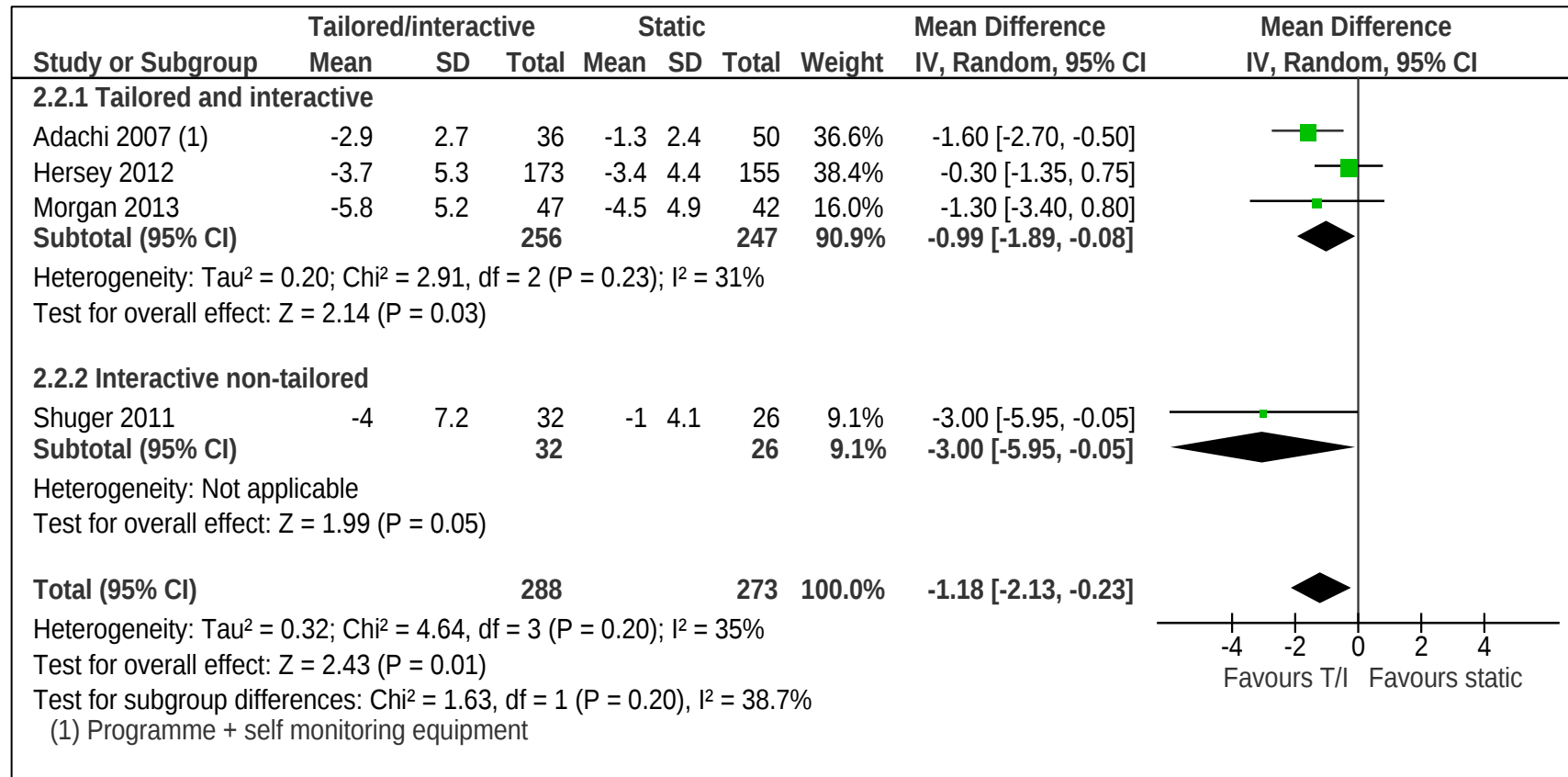


Figure 12 Interactive and tailored programmes compared with fixed programmes, complete case weight change at six months



3.4.3 Changes in behavioural processes

Though all of the included interventions contained behavioural strategies and processes identified in the OxFAB taxonomy, very few reported on the degree to which participants enacted these processes. Where processes were measured, they related to the restrictions, allowances, self-monitoring, social support, and information seeking domains.

Five studies reported some measure of restrictions. Two used restraint scales (145, 152), and three advised participants to restrict fat or alcohol intake and reported on these behaviours.(140, 142, 144) Four of the five detected a significant difference in restraint/restricting intakes between the most intensive (tailored/interactive) and least intensive (fixed or control) arms. Of these, two also detected a significant difference in weight loss in favour of participants receiving the most intensive interventions. Two studies reported changes in consumption of fruit and vegetables and dietary fibre ('allowances' in the OxFAB taxonomy).(142, 145) Both detected significant effects in favour of the intervention for increases in amount consumed per day, but neither detected a significant difference in weight change.

Three studies measured frequency of self-monitoring. One study comparing an interactive with a fixed programme (both groups received podcasts and print materials; intervention participants were also provided with a mobile phone app) did not detect a significant difference in mean days per week that participants recorded their diet or physical activity between groups; no significant difference in weight loss was observed.(164) In the other two studies (one comparing a mobile phone app with text messages to print and web interventions; the other comparing a web-based intervention to a minimal control), authors observed a greater increase in self-monitoring behaviour

in intervention participants than in controls, but did not quantify this; these studies also did not detect a significant difference in weight change.(145, 151)

Two studies measured changes in social support. A cluster-randomized church-based study comparing a mobile phone app with text messages to print and web interventions found no significant difference in measures of social support related to diet or physical activity, using the authors' own measures; differences in weight change were minimal (-0.2 kg (SD 0.4) in intervention versus +0.1 kg (SD 0.5) in control).(145) The second study compared a tailored and interactive intervention via smartphone that incorporated podcasts with a fixed intervention consisting of podcasts only; significantly more participants in the smartphone group reported that their main weight-related social support was through online resources at study end, but there was no significant difference in weight change.(164)

Finally, in one study which compared a minimal control to an intervention including text messages and a website with links to further information sources on diet and physical activity, intervention participants were more likely to have searched for further information on diet and physical activity than controls at study end.(154) Intervention participants also lost significantly more weight.

3.4.4 Socioeconomic status

I examined socioeconomic status in two respects: participant characteristics at baseline and whether the effectiveness of the intervention was modified by participants' socioeconomic status. Further detail on the participant characteristics discussed in this section can be seen in Table 12.

Table 12 Participant characteristics as they relate to socioeconomic status⁷

Study ID	Relevant inclusion criteria	Baseline demographics ⁸	Notes re: baseline characteristics
Beeken 2013(148)	Recruitment to represent ethnically diverse or socioeconomically deprived	Deprivation (IMD) quintiles: 1 (most deprived): 5.5; 2: 18.8%; 3: 30.4%; 4: 21.9%; 5 (least deprived): 23.4%	
Carter 2013(151)	Employed by large employer in Leeds; read and write English; internet access	58% managerial/professional	
Collins 2013(152)	Access to a computer with e-mail and internet facilities	Highest level of education: High school: 30%; Trade/diploma: 35%; University: 23%; Higher university degree: 13% Weekly household income (AUD): <700: 8%; 700 to <1000: 6%; 1000 to <1400: 12%; ≥1500: 66%	Recruitment conducted in 2009. Gross household income per week in Australia from 2009-2010 was averaged to be 1,688 AUD.(167) Compare education level with 45% of Australians aged 25-34 having tertiary education in 2010.(168)
Haapala 2009(154)	Access to a mobile phone and internet connection	Highest level of education: Vocational school: 17%; College degree/baccalaureate: 61%; Graduate degree: 16%	Compare with 85% of the tertiary age in tertiary education in 2002(169)
Jeffery 1982(156)	None stated	Over 90% had some university education	Compare with 58% in US having at least some college in 2013(170)
Johnson 2008(157)	None stated	Income (USD): < 25,000: 4%; 25-50,000: 26%; 50-75,000: 34%; ≥ 75,000:36% Employment: Full time: 86%; Part time: 5%; Homemaker: 3%; Retired: 4%; Unemployed: 1%; Unable to work: 2%	Not clear if income represents individual or household. Not clear when recruitment took place. Median household income in US in 2005 was 26,242 USD.(171)
McConnon 2007(158)	Access the internet at least once per week; read and write in English	None specified	

⁷ Studies only listed where relevant information reported

⁸ Total across all included arms

Study ID	Relevant inclusion criteria	Baseline demographics ⁸	Notes re: baseline characteristics
Morgan 2011(141)	Access to a computer with email and internet facilities	SEIFA Index of Relative Socioeconomic Advantage and Disadvantage: tertile: 1–2 (lowest): 2%; 3–4: 23%; 5–6: 23%; 7–8: 42%; 9–10 (highest): 9%	
Morgan 2013(140)	Access to a mobile phone and a computer with email and Internet facilities	SEIFA Index (as above): 1–2 (lowest) 5.7%; 3–4: 15.7%; 5–6: 36.5%; 7–8: 29.6%; 9–10 (highest): 12.6% Weekly household income (AUD): <1000: 12.7%; 1000-1500: 17.7%; ≥1500: 66.5%; Unknown: 3.2%	Recruitment conducted in 2010. Not clear how weekly household income was measured but gross household income per week in Australia from 2009-2010 was averaged to be 1688 AUD.(167)
Patrick 2011(142)	None stated	Education (highest level attained): Some high school/high school graduate: 8.4%; Some college: 28.6%; University graduate: 29.9%; Postgraduate training: 33.1%	Compare with 32% US population in 2013 having undergraduate degree (170)
Rothert 2006(160)	Members of HMO; regular internet access; e-mail address	None specified	
Shapiro 2012(161)	Internet access; cell phone; uses SMS; read and speak English	59% university	Compare with 32% US population in 2013 having undergraduate degree (170)
Shuger 2011(162)	Access to the internet	4-year college degree 77%	Compare with 32% US population in 2013 having undergraduate degree (170)
Tate 2006(163)	Availability of a computer with internet access	54% university graduate	Compare with 32% US population in 2013 having undergraduate degree (170)
Turner-McGrievy 2011(164)	Access to scale; smartphone or iPod touch; internet access; comfortable using computer	University or less 45% Graduate degree 55%	Compare with 32% US population in 2013 having undergraduate degree (170)
Winett 2007(145)	None stated (church attendees)	Income, level of education, and occupation measured but none reported	
Wylie-Rosett 2001(146)	None stated	≥1 year university 83%	Compare with 58% in US having at least some college in 2013 (170)

3.4.4.1 Participant characteristics

As seen in Table 12, 12 of the 23 included studies had inclusion criteria that may have affected the socio-demographic range of participants recruited, with 11 of the 12 potentially biasing the recruitment towards more advantaged populations. Nine studies required that participants had access to the internet, four required that participants own a smartphone, and three (conducted in English speaking countries) required that participants be able to read and write in English. In addition, one required participants to own a weighing scale (164), one only recruited employees working for large employers in the study area (151), and one recruited exclusively from a US health maintenance organization (HMO), which required participants or their employers to pay for healthcare.(160)

Nine studies did not report the socioeconomic profile of participants. Three reported some measure of relative indexes. Two Australian studies reported the percentage of participants in tertiles of the SEIFA Index of Relative Socioeconomic Advantage and Disadvantage. In both studies, more than 40% of participants fell in the top tertile and less than 25% fell in the bottom tertile.(140, 141) One UK study reported participants by deprivation (IMD) quintiles, with one representing the most deprived and five representing the least deprived; 45% fell between four and five whereas 24% fell between one and two.(166)

In studies that did not report indexes, I examined other characteristics related to socioeconomic status. Education was the most commonly reported, with nine studies providing at least some measure of education level. Due to the range of measures reported, it is difficult to generalize across studies. The majority of participants had a university degree in five of the six studies that reported on this particular variable. The

other three studies reported different measures of educational attainment (Table 12). Three studies reported income at baseline: in two Australian studies 66% of participants had a weekly household income greater than or equal to 1,500 AUD (140, 152)(compared to weekly average of 1,668 in 2010 (167)) and in one 70% reported an income of greater than or equal to USD 50,000 (157) (compared to a median household income in the US in 2005 of 26,242 USD (171)). Two studies reported on employment; in one US study, 86% of participants were in full time employment at baseline (157) and in one UK study involving recruitment via employers, 58% of participants were in a managerial or professional role.(151)

3.4.4.2 Study outcomes

Only one study examined the interaction between socioeconomic status and group assignment.(148) This data, presented at a conference and unpublished at the time of writing, showed strong evidence of a statistically significant interaction such that the intervention appeared more effective for people of higher socioeconomic status. A second study examined the association between adherence (defined as participants in the intervention arm who completed eating and exercise diaries approximately four days a week and recorded their weight weekly) and levels of advantage/disadvantage (using the SEIFA index) and did not detect a significant relationship.(140)

Three studies examined the relationship between education level and outcomes but without assessing an interaction with treatment assignment. A study in Finland was the only one to examine the association between education and weight change; there was a significant positive association between level of education and percent weight loss at 12 months.(154) An Australian study found that the adherent participants (participants in the intervention arm who completed eating and exercise diaries approximately four days

a week and recorded their weight weekly) were significantly more likely to have some post-school qualification than less adherent participants ($p = 0.002$).⁽¹⁴⁰⁾ In contrast, a US study of a text-message based intervention reported no significant relationship between adherence (defined as number of responses to automated text messages) and level of education.⁽¹⁶¹⁾ One further study controlled for education in their linear mixed model for weight change, but did not report whether the association was significant.⁽¹⁶²⁾

3.5 Discussion

3.5.1 Summary of main findings

This systematic review of randomized controlled trials of self-help interventions found that these interventions led to modest but significant weight loss at six months compared with minimal interventions. Tailoring and interactivity of programmes appeared to increase weight loss. However, results were variable and the reasons for this heterogeneity remain largely unknown. In addition, in the small group of studies providing data at 12 months, weight loss was no longer significant; the effect size was comparable with that achieved at six months but was imprecisely estimated. Due to lack of detail in the original reports, I was unable to quantify relationships between OxFAB domains, behavioural processes and weight change. However, in the studies which measured the degree to which participants enacted behavioural processes, all which detected a significant difference in weight change also reported a significant difference in behavioural processes in favour of intervention arms.

This review highlights the paucity of data to address the critical question of how to narrow inequalities in obesity, with studies often neglecting to report effects in relation

to socioeconomic status or with populations so homogenous as to preclude analyses of this sort. Most of the included studies were biased towards participants with relatively high socioeconomic status, as is also the case in trials of more intensive weight loss interventions.(172) The only trial that examined a potential interaction with socioeconomic status found that the intervention was more effective for more advantaged populations.(148) Crucially, more intensive face-to-face behavioural programmes show no evidence of a difference in effectiveness by social group.(172) This may suggest that more support is needed for participants from lower socioeconomic status groups than can be provided by self-help interventions alone. There is currently insufficient data with which to definitively establish the effectiveness of self-help interventions in socioeconomically disadvantaged groups, and more inclusive research into these programmes is needed.

3.5.2 Strengths

This review has a number of key differences from other reviews of ‘self-help’ interventions, which highlight its strengths. By focussing on those interventions requiring minimal person-to-person input, the review has not been limited by format type but rather has examined interventions across a range of mediums, an increasingly relevant issue given the blurring boundaries between formats (e.g. mobile phones and computers) and growing interest in how components of programmes influence their effectiveness. Though this review overlapped with some reviews of web-based interventions, over a third of the included studies had no internet components and were not included in previous format-specific reviews. The scope I employed allowed this review to isolate the effects of true ‘self-help’ interventions from the more resource-intensive elements of human input that other reviews of this type have included. By

shifting the focus from format to content, I have been able to evaluate the added benefits afforded by tailoring and interactivity (across a range of format types) and to categorize the self-management strategies recommended in these trials using the OxFAB taxonomy.

The approach taken to assessing the outcomes is also a strength of this review. The use of BOCF to standardize the presentation of data from each study removed a potential spurious cause of differences between studies, and arguably is more suitable to assessing population level impact than complete case analysis, though complete case analyses yielded similar results. In addition, by restricting analyses to trials lasting six months or longer, I have been able to evaluate effects at defined and longer time points than some previous reviews, which have pooled short and longer term follow-up data.

3.5.3 Limitations

Even though a strength of this review was its ability to evaluate effects at defined and longer time points than other reviews in this area, most studies were of short duration and insufficient data hampered my ability to determine the effects of such interventions at 12 months or longer. Furthermore, many of the included studies were at high or unclear risk of bias, most commonly because of poor reporting or use of a wait list control, limiting confidence in findings from some comparisons with fewer studies.

Though the OxFAB taxonomy was successfully used to hone in on the behavioural processes recommended by the interventions contained in this review, insufficient data meant I was unable to quantify the relationship between weight change and the recommendation or initiation of specific behavioural strategies. In addition, this analysis was limited in that I coded solely for the presence of OxFAB taxonomy domains, and

was unable to take into account the emphasis placed on individual strategies or the rigour with which they were enacted within individual programmes due to an inability to access the full programme material offered to participants across the included studies. Unfortunately, this is typical in analyses that code intervention components using taxonomies.(68, 100) As a result, recent reporting standards for complex interventions call for more thorough and consistent descriptions of intervention content and linking through to intervention materials, where available.(95)

3.5.4 Comparisons with other reviews in this area

Due to the scope of this review, it is difficult to directly compare these findings as a whole with existing reviews. A 2014 review of reviews also employed a multi-format approach and concluded that evidence was mixed, but suggested self-directed interventions could promote weight loss either on their own or as an adjunct to more intensive therapies.(128) Of those format-specific reviews that have compared purely self-directed interventions with minimal controls, findings are consistent with my pooled results.(173, 174) Previous reviews have used a taxonomy of behaviour change techniques, explicitly designed to characterize intervention components from the perspective of intervention delivery.(68, 73, 94, 98) As the programmes evaluated in this review were more self-directed than interventionist led, the OxFAB taxonomy was more appropriate as it was designed to characterise intervention content from the perspective of strategies (potentially) used by the participant.

The above-mentioned review of reviews highlights individualized feedback, email counselling, and online social support as programme characteristics that could increase effectiveness.(128) The majority of the interventions included in this review did encourage users to seek social support (whether via online forums or participant-

directed), but did not include email counselling or feedback unless these were automated. A 2012 review of technology interventions to combat obesity found that, regardless of format, the interventions all included educational components, and encouraged participants to set goals and monitor performance against these.(126) Similarly, my review found self-monitoring and goal setting to be employed across the vast majority of included programmes, which is encouraging in the light of evidence suggesting these self-regulatory behaviours are associated with greater weight loss in the context of other interventions.(98)

3.5.5 Conclusions and implications

This review raises several considerations regarding the role of self-directed interventions for weight loss, and suggests they may be a promising avenue for future intervention design. As risk is linearly related to excess body mass index (see Chapter 1), even modest reductions in weight in the range of those observed in these studies can have long-term health benefits for people who are overweight or obese, suggesting there is a role for recommending self-directed interventions people with overweight or obesity who want to lose weight.(32) Given the potential scalability and relatively low cost of this type of intervention, self-help programmes may be a useful baseline intervention within a portfolio of population-wide strategies to treat overweight and obesity. Even with such modest weight loss, if these interventions were widely taken up, the impact of many people losing weight in the ranges observed here could have substantial impact on population health and associated costs. However, confidence in the use of such interventions would be increased were we able to determine their effect at longer than six months. Currently, it is difficult to determine if the lack of a statistically significant effect on weight change at 12 months is due to weight regain

after six months, due to a limited sample size, or to heterogeneity in programme effectiveness. Further studies reporting data at 12 months or longer would help clarify this situation.

Crucially, identification of the most effective components of these interventions would also increase confidence that implementing programmes containing these elements would be effective, even though the format of delivery will inevitably evolve with improvements in technology. The OxFAB taxonomy has been designed to facilitate such identification, and Chapter 4 describes its use in identifying those strategies associated with greater weight loss amongst participants of the OxFAB cohort study.

Chapter 4 The OxFAB cohort study

4.1 Summary

This chapter presents the design, methods and results of a prospective, web-based cohort study of adults with overweight or obesity in the UK trying to lose weight through behaviour change. The study set out to assess the cognitive and behavioural strategies used for weight loss and their associations with weight change. Strategy use was assessed using the OxFAB questionnaire (see Chapter 2) and evaluated (1) at the domain level, (2) through exploratory factor analysis, and (3) in a model of strategies deemed a priori to be “essential” to weight management. Associations with weight change at 3 months were tested using linear regression. Four hundred and eighty-six participants answered all questions; 194 reported weight at baseline and at three months. Greater weight loss was significantly associated with three domains - motivational support, information seeking, and self-monitoring, as well as with dietary impulse control (from factor analysis) and weight loss planning and monitoring (from factor analysis). Higher scores in the model of essential behavioural strategies were significantly associated with greater weight loss (compared to participants using six or fewer of the nine strategies, using seven or more was associated with a 2.13 kg greater weight loss (SE 0.58, $p < 0.001$)). In conclusion, despite heterogeneity in the strategies employed for weight loss, coherent patterns of behaviours emerged for individual participants, some of which were associated with greater weight loss. Future trials could test the effect of promoting use of these patterns on the extent of weight loss.

Note: A version of this analysis has been submitted as an article to *BMC Public Health* and is currently under review.

4.2 Introduction

There is a paucity of data on the particular strategies people themselves employ in self-directed weight loss attempts and their effectiveness (Chapter 1). This is a critical knowledge gap since evidence of the effectiveness of behavioural interventions is almost entirely derived from strategies that have been shown to be effective in the context of intensive interventions, typically involving face-to-face contact with trained staff. The OxFAB questionnaire (Chapter 2) differs from existing questionnaires designed to explore weight-related behaviours that primarily focus on quantifying and qualifying energy intake and expenditure, measuring the end result of a myriad of behaviours as opposed to the cognitive and behavioural strategies individuals adopt, and which lead to the recorded diet and activity levels. The cohort study presented in this chapter is the first to use the OxFAB taxonomy and questionnaire to assess the cognitive and behavioural strategies used for weight change in adults with overweight or obesity attempting to achieve weight loss, and to examine the associations between strategies from the OxFAB taxonomy and weight change after three months of follow-up.

4.3 Methods

4.3.1 Recruitment and inclusion criteria

The study was approved by the University of Oxford Central University Research Ethics Committee (MSD-IDREC-C1-2014-204). Recruitment started in January 2015 and this chapter presents an analysis of data collected from January to November 2015. Participants were recruited from the general public on a rolling basis, through a number of recruitment channels. As a primary driver for recruitment, the study was launched to

coincide with a television programme on weight loss airing nationally throughout the UK ('The right diet for you') in which my supervisors were involved. The television programme itself was in no way linked with my study, but the programme had associated websites including 'iWonder guides' created by the BBC with interactive elements. Two of these iWonder guides ('Does fat run in families?' and 'Why do I feel hungry?'⁹) included a short advertisement linked to our study recruitment website, which read "Oxford University: Help researchers with a weight loss study". In addition, the study was publicised on social media, to people who had previously been involved or expressed interest in other studies being led by the Health Behaviours team at the University of Oxford, and via a local health improvement service (Here for Health, based at the John Radcliffe Hospital). Participants were encouraged to share information on the study with family and friends. The system was open to anyone who wished to register and was over the age of 18, but to be included in this analysis, participants were required to be overweight adults (BMI greater than or equal to 25 kg/m², aged 18 or older), resident in the UK, and trying to lose weight through changes to their diet, physical activity, or both. These criteria were set out in the data analysis plan, agreed before study start (see Appendix 2).

4.3.2 Data collection

A bespoke, cross-platform mobile phone application and a study website (www.oxfab.org) were created to collect data, which were hosted on a secure server at the University of Oxford.

⁹ accessed via <http://www.bbc.co.uk/guides/z3ddwmn> and <http://www.bbc.co.uk/guides/zt22mp3>, respectively

4.3.2.1 Website and mobile application design

The website and mobile phone application were designed and developed with colleagues from the Department of Engineering, a collaboration made possible by funding from the NIHR CLAHRC Oxford. The mobile phone application was designed after the website had been finalised, using commercial software for replicating web content on a variety of mobile devices. I project managed the web-development process, leading regular meetings and repeatedly testing and feeding back on website iterations via a change management process. This process began with a meeting with colleagues at the Department of Engineering, after which I drafted a list of required and desirable website features (see Appendix 3), which was used as a starting point for conversations about website functionality and design. An external designer was used to help choose colours and logos. Once the initial version of the website had been agreed by myself and the developers, the website was sent to ten participants who conducted usability testing to highlight any issues with functionality (see Appendix 4). Issues arising from this testing were addressed before a soft launch in early January; the website was then openly advertised a fortnight later. Frequently asked questions were prepared according to anticipated demands, and amended throughout the project in line with queries from users.

4.3.2.2 Website functionality

Screenshots of the website with added commentary explaining design features can be found in Appendix 5. In summary, before registering, participants were shown participant information and asked to provide informed consent, using wording agreed with the University's Central Ethics Committee (see Appendix 5). As this was a web-based study, informed consent was achieved through web functionality that required

participants to provide informed consent before progressing with the study, as per centrally agreed protocols. At baseline, participant demographics (age, gender, ethnicity, highest level of education obtained) and self-reported weight and height were collected. Participants were asked to log in episodically, as frequently or infrequently as they liked, to indicate which specific strategies they were using. Every time they logged in, participants could navigate to a page on which to record their weight. However, they were not prompted to do so unless they had not entered their weight in the last three months, as I wanted the website to minimise prompts to self-weigh, as this in itself was a strategy. If participants had not weighed themselves at the time of the prompt, they could indicate this and would not be prompted again. To avoid crashing due to overload at study launch, website capacity was maximised and registration emails were controlled via a central facility. The main function of the website was to present multiple choice questions from the OxFAB questionnaire (see Chapter 2), which were presented 10 at a time.

4.3.2.3 Encouraging use and retention

In addition to the prompt to enter weight if participants had not done so in the past three months, eight months after the study opened, participants were incentivised to enter their weight to be eligible for a prize draw for one of five £20 Amazon vouchers. Other than this, no recruitment or retention incentives were offered to participants, so particular thought was given to providing web functionality which would encourage participant use and minimise user burden. This included asking a limited number of questions per page; after a user answered these questions, they were given the option to answer another set of 10 questions. This design was chosen to diminish the burden felt by participants in light of the large number of questions in the question bank. In

addition, both the website and the mobile phone application allowed participants to visualise their weight progression on a graph and receive simplified statistics about the strategies they reported using. Initial feedback suggests these tools were well-received; when I informed participants the study would be closing, I had numerous requests to continue to keep the website available; we honoured these by keeping the site open for a further year.

In addition, participants could register to receive e-mail prompts to log in to the website on a daily, weekly, or fortnightly basis, or choose to opt out of prompts. A further tool to encourage retention was regular contact with participants via a newsletter that shared small insights from the study; these insights were carefully chosen to minimise impact on participant strategy use (e.g. general overview of differences in strategy use by gender, no information provided on associations with weight change). Three of these newsletters were sent out over the course of the study via email, with an automated link for opting out. The final newsletter, circulated at study close, contained an infographic created through consultation with the Oxfordshire CLAHRC communications manager, which displayed preliminary results from the study and can be seen in Appendix 6. This infographic has since received an ‘Honourable Mention’ in the Outreach and Public Engagement category at the 2016 OxTALENT awards. These awards recognise members of the University who have made innovative use of digital technology in order to improve impact through outreach and public engagement.

4.3.3 Classification of strategy use

The OxFAB questionnaire (see Chapter 2) was used to establish which strategies were being employed by participants to manage their weight. At baseline, participants were

asked three yes/no screening questions to rule out questions that were irrelevant to them, namely:

- Are you trying to exercise or be more active as a way to lose weight?
- Are you changing your diet as a way to lose weight?
- Do you do the food shopping for yourself/your household?

Accordingly, participants who were not using diet to control their weight were not asked questions specific to diet, participants who were not using physical activity to control their weight were not asked questions specific to physical activity, and participants who did not shop for their own food were not asked questions about food shopping. After irrelevant questions had been screened out, participants were asked all remaining questions from the OxFAB questionnaire in a randomly generated order. As described in Chapter 2, for each question, participants were asked to indicate if they used the strategy most of the time, sometimes, or never/hardly ever. ‘Not relevant’ was also provided as an answer option, and participants had the facility to mark individual questions as unclear.

4.3.4 Data analysis

Analyses were conducted using Stata v11.(175) Participants were excluded if they had missing data for one or more of the strategies relevant to them or if, when calculated using self-reported weight and height data, their BMI at baseline was less than 25. For analyses of associations between strategy use and weight change at three months, participants were excluded if they had not provided a self-reported weight at 75 to 105 days from baseline (e.g. from when the individual participant first enrolled in the study, at which point they were required to enter their baseline weight). Baseline differences

between those who completed all questions, those who did not, and those who did not provide weight data at three months were calculated using unpaired t-tests for continuous variables and using Pearson's chi square tests for binary and categorical variables.

In the primary analyses, strategy use was defined dichotomously, with 'most of the time' and 'sometimes' considered as use of that strategy, and 'never' and 'not relevant to me' considered as not using that strategy. Domain use was evaluated in two predefined ways: as percentage of strategies used within each domain, and as use of at least one strategy within a domain. These two approaches were used as domains contained varying numbers of strategies.

4.3.4.1 *Factor analysis*

Data-driven patterns of strategy use were derived by exploratory factor analysis for binary variables using a *tetrachoric* correlation matrix with orthogonal rotation (*varimax* option) to enhance factor identification and interpretability.(176, 177) Factors were retained based on eigenvalues greater than 1, the proportion of variance explained, and factor interpretability. For each factor identified, every strategy has a factor loading which is the correlation coefficient between each strategy and the factor. Only the strategies with factor loadings (*z-score*) greater than 0.2 were retained and extracted in the factors identified.(178) For each factor identified, factor scores were derived for each participant, with higher scores indicating higher adherence to that factor (e.g. higher usage of the strategies contained in each factor). As the term 'factor' can connote other analysis methods, these are described as patterns in the remainder of this chapter.

4.3.4.2 *Model of essential strategies for weight loss*

In addition to the factor analysis, I conducted a non-data driven exploratory analysis testing an *a priori* model which included only those strategies that were deemed essential to weight management. This strategy model was created by myself and my supervisors based on existing knowledge, literature, and theory.(179, 180) It contained nine components, which are itemised in Table 13. As illustrated in this table, some components of the model consisted of more than one strategy; where this was the case use of at least one strategy within that component counted as use of that component. Each participant was given a score of 0 to 9 with each component of the model equally weighted (use of that component = 1).

4.3.4.3 *Statistical analysis*

A linear multivariable regression model was used to examine associations between demographic characteristics and each pattern, and between demographic characteristics and domain use. A linear regression model was used to explore associations between strategy, pattern and domain use and weight at three months controlling for baseline weight.(181) I then tested whether participants' scores for the model of essential strategies for weight loss were associated with weight at three months controlling for baseline weight using a linear regression model with a continuous scale (0 to 9) and a binary scale (use of seven or more strategies within this model). For each analysis, all model assumptions for using parametric tests were checked and met. All analyses were exploratory and *p values* should be taken as indicative. As the analyses were exploratory and hypothesis-generating rather than hypothesis-testing, I did not adjust p-values for multiple measures (e.g. Bonferroni correction).

Table 13 Strategies included in individual components of the model of essential strategies for weight loss

Component		Question ('use' defined as use of at least one strategy within a component 'most of the time')
1	Food intake targets	I set myself goals for what or how much I'll eat each day or each week
2	Weight targets	I have a goal weight in mind that I am working towards I have a clear goal for the amount of weight I want to lose each week
3	Impulse management strategy relating to food	When I feel like eating something that doesn't fit with my diet, I acknowledge the feeling but don't act on it If I feel like eating but am trying not to, I find something else to do to distract myself When I have a craving for something I shouldn't eat, I try to think about something else to take my mind off it If I feel like eating but am trying not to, I make myself wait a certain amount of time to see if the craving passes If I feel like eating but am trying not to, I chew gum, drink something, or brush my teeth to stop me from doing so I try to go to sleep as a way to not eat when I am feeling hungry If I feel like eating but am trying not to, I pause and ask myself if I'm hungry
4	Motivation strategy	I use pictures of myself, other people, events, or places to remind me why I want to lose weight I look at clothes that I would like to wear but are currently too small to boost my motivation to lose weight I keep a note or a record to remind myself of my reasons for losing weight I keep myself motivated by reminding myself of the reasons I want to lose weight I use a chart, graph or diary to track my progress in losing weight I use an online program or app to look at my body shape and how it could change I draw on my values about what is important in life to motivate me to lose weight If I've reached one of my weight loss targets, I will reward myself with something that isn't food I've designated certain times/days as points where I don't have to stick to my diet, in order to reward me for sticking to it at other points I am trying to lose weight alongside a friend/family member/my partner I feel like I am part of a team with my friend(s)/partner/family member. We are losing weight together. I have an online weight loss buddy I told other people about my weight loss goals to help me stick to them I've promised other people I'll lose a certain amount of weight I am losing weight with a friend/family member/my partner and I'm trying hard to lose more than them
5	Meal planning	I plan my meals in advance to manage my weight
6	Food swaps	I would swap one type of food or drink for another if I knew one would be better for my diet (e.g. lower fat or lower sugar versions of foods I normally eat)

Component		Question ('use' defined as use of at least one strategy within a component 'most of the time')
7	Self-weighing	I keep track of my weight by weighing myself
8	Monitoring food	I keep track of the calorie and/or nutritional content of the things I eat I check the portion sizes of the things I eat
9	Keeping unhealthy food out of the house	To avoid eating or drinking things that don't fit with my diet, I don't keep them at home

4.4 Results

4.4.1 Participant characteristics

Four hundred and eighty-six participants answered all survey questions presented to them at least once (survey completers), representing approximately 40% of the eligible participants who began registration (1,202 in total). Survey completers were significantly more likely to have a university degree than non-completers ($X^2 = 21.80$, $p < 0.001$), to be of White British/Irish ethnicity ($X^2 = 14.41$, $p = 0.006$) and to be older (mean age completers 50.3 years (standard error (SE) 0.69) versus 46.2 years (SE 0.65), $p < 0.001$). No other demographic characteristics were associated with survey completion. Baseline demographics for survey completers are reported in Table 14. The majority of participants were White British/Irish with a university degree. The mean BMI at baseline was 33.14 kg/m² (SD 6.52) and the mean weight was 91.37 kg (SD 18.38). The majority of participants were female (85%).(68) Eighty four percent of participants were attempting to lose weight through changes to both their diet and physical activity, 2% were changing only their physical activity, and 13% were changing only their diet.

4.4.2 Strategy and domain use

4.4.2.1 Use of individual strategies

On average, participants used 39 (SD 12) strategies some of the time and 29 strategies (SD 14) most of the time (out of 117 strategies in total). The number of participants reporting use of each individual strategy varied considerably (see Figure 1); on average, each strategy was used by 284 participants (58%). Six strategies were used by over 90% of participants at baseline:

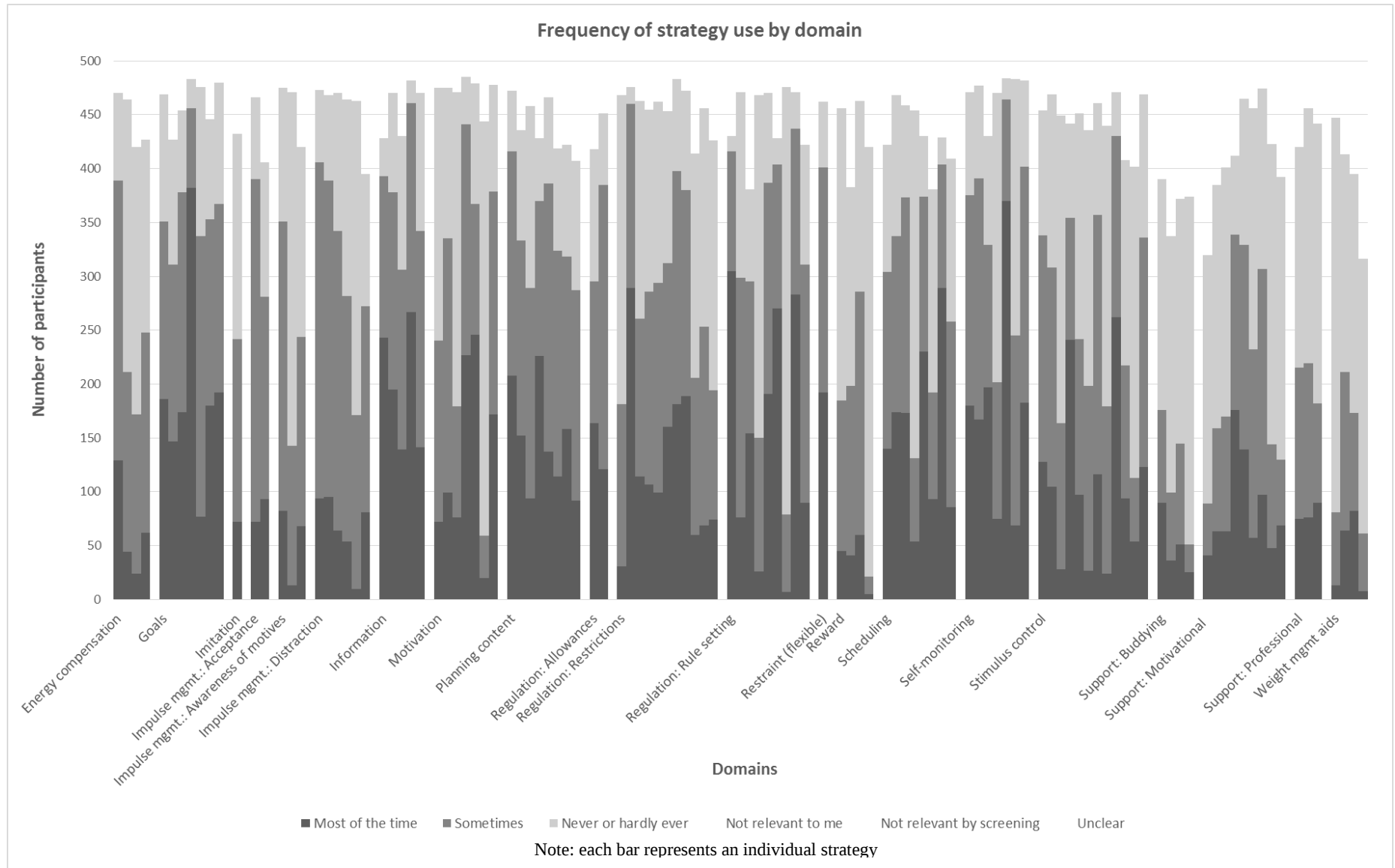
- I keep track of my weight by weighing myself
- I've looked up strategies, tips or plans for how to lose weight
- To help me manage what I eat, I try to avoid eating certain foods
- I have a goal weight in mind that I am working towards
- I keep myself motivated by reminding myself of the reasons I want to lose weight
- I would swap one type of food or drink for another if I knew one would be better for my diet.

Table 14 Baseline demographics of survey completers

Characteristic	Participants (n = 486)	
Gender	414 (85.36%) Female (1 missing)	
Age (mean, SD)	51.81 years (11.56)	
Ethnicity	Black	2 (0.41%)
	British/Caribbean/African	
	Mixed and others	33 (6.79%)
	None selected	3 (0.62%)
	South Asian	6 (1.23%)
	White British/Irish	442 (90.95%)
Highest level of education completed	No qualifications	5 (1.03%)
	O/A level or equivalent	129 (26.54%)
	University degree	350 (72.02%)
	None selected	2 (0.41%)
Baseline BMI (mean, SD)	33.14 (6.52)	
Baseline weight (mean, SD)	91.37 kg (18.38)	

Diet and/or exercise to lose weight	Both	407 (84%)
	Exercise only	10 (2%)
	Diet only	65 (13%)
	Missing	4 (1%)
Heard about study	Involved in another weight loss study	21 (4.32%)
	Online advertisement	145 (29.84%)
	Other	299 (61.52%)
	Through a friend/family member	21 (4.32%)

Figure 13 Frequency of strategy use by domain



4.4.2.2 Patterns of strategy use

Factor analysis revealed five meaningful patterns of strategy use (Table 15). Patterns were conceptually coherent and I have assigned names to each to aid interpretation.

Table 15 Strategy patterns

Pattern		Groups of strategies
1	Physical activity	I set myself goals for how active I'll be each day or each week
		I schedule physical activity into my week
		I follow an exercise plan/routine
		I do something to prompt me to exercise (e.g. lay out my exercise clothes the night before)
		If I feel like I want to stop exercising, I focus on something else to distract me so that I keep going
		When I'm being active, I push myself to my limits
		I keep track of the physical activity that I do
		I've chosen a type of physical activity I prefer in order to keep it up
		I give up something else to make time for exercise (e.g. watching TV, socializing, leave work early)
2	Dietary impulse control	I use smaller plates, bowls or glasses when eating to help with my portion control
		When I have a craving for something I shouldn't eat, I try to think about something else to take my mind off it
		If I feel like eating but am trying not to, I make myself wait a certain amount of time to see if the craving passes
		If I feel like eating but am trying not to, I pause and ask myself if I'm hungry
		Part way through eating a meal, I pause and ask myself if I'm full enough to stop
		I slow down how quickly I eat in an effort to eat less
3	Support	I've tried to get the people I live with to encourage my weight loss plans
		I've tried to get my friends and family to support me in managing my weight
		I've promised other people I'll lose a certain amount of weight
		I belong to a group of people who are trying to lose weight together (for example, an online discussion forum, a group of colleagues all trying to lose weight)
		I am losing weight with a friend/family member/my partner and I'm trying hard to lose more than them
		I feel like I am part of a team with my friend(s)/partner/family member. We are losing weight together.
		I use a weight loss service to help me manage my weight (for example, Weight Watchers, Slimming World, Lighter Life)

Pattern		Groups of strategies
4	Food purchasing strategies	When I'm grocery shopping and items of food look similar, I make my choice based on the nutritional information on the food labels
		I plan my food shopping in advance to help me stick to my diet (e.g. use a shopping list)
		To avoid eating or drinking things that don't fit with my diet, I don't keep them at home
		When I go food shopping, I try to only buy the types of food that I know I should be eating
		When I am food shopping, there are certain foods I stay away from to help me stick to my diet
		I plan when I am going to do my food shopping to make sure it's not at a time when I am really hungry
5	Weight loss planning and monitoring	I use a chart, graph or diary to track my progress in losing weight
		I use a book, website or app to look up the nutrition information and/or calorie content of the foods I eat
		I have a clear goal for the amount of weight I want to lose each week
		I check the portion sizes of the things I eat
		I have a weight management plan, but I allow myself to be flexible about what I do depending on circumstances

4.4.2.3 Domain use

When defined as use of at least one strategy within that domain, the mean number of domains used per participants was 18.4 (out of 21) (SD 1.84), ranging from 7 to 21 domains. Goals, impulse management: distraction, motivation, restrictions, rule setting, scheduling, self-monitoring and stimulus control were the most commonly used domains (over 95% of participants using at least one strategy within that domain). Table 16 shows the frequency of use of each domain, defined both as average percentage of strategies used within that domain and use of at least one strategy within each domain.

Table 16 Frequency of use of each domain

Domain	Use of at least one strategy within domain		Proportion of strategies used within domain	
	Mean	SD	Mean	SD
(n = 486)				
Energy compensation	90%	31	52%	32
Goals	100%	6	75%	20
Imitation	50%	50	50%	50
Impulse management: acceptance	92%	27	69%	31
Impulse management: awareness of motives	85%	36	51%	31
Impulse management: distraction	96%	16	64%	25

Domain	Use of at least one strategy within domain		Proportion of strategies used within domain	
Information seeking	100%	6	77%	21
Motivation	100%	5	59%	21
Planning content	100%	6	71%	21
Allowances	89%	32	70%	34
Restrictions	99%	9	60%	19
Rule setting	99%	8	64%	18
Restraint	83%	38	83%	38
Reward	81%	39	35%	24
Scheduling	99%	10	58%	22
Self-monitoring	100%	0	71%	20
Stimulus control	99%	10	55%	19
Support: buddying	42%	49	22%	28
Support: motivational	94%	23	41%	23
Support: professional	75%	43	42%	32
Weight management aids	72%	45	27%	22

4.4.3 Associations between demographics and patterns of strategies and domain use

People with a university degree had on average a 0.23 higher score (95% CI 0.01 to 0.44, $p = 0.04$) on the physical activity pattern and a 0.31 higher score (95% CI 0.13 to 0.49, $p < 0.001$) on the support pattern than people without a university degree. Men used significantly more strategies than women overall (8.46, 95% CI 4.81 to 12.10, $p < 0.001$) and had significantly higher factor scores for the dietary impulse control pattern (0.43, 95% CI 0.16 to 0.70, $p = 0.002$), the support pattern (0.49, 95% CI 0.24 to 0.75, $p < 0.001$) and the food purchasing strategies pattern (0.70, 95% CI 0.48 to 0.92, $p < 0.001$). There were no other significant associations between number of strategies used and participant characteristics, or between participant characteristics and factor scores for the weight loss planning and monitoring patterns. At the domain level, men again used significantly more domains than women (0.87, 95% CI 0.42 to 1.32, $p < 0.001$), with no other associations between participant characteristics and number of domains used. Table 17 indicates where there were significant associations between demographic characteristics and levels of domain use.

Table 17 Associations between domain use and participant characteristics

Domain	Significant association when defined as use of at least one strategy within that domain	Significant association when defined as percentage of strategies used within that domain
Energy compensation	University degree (0.07, 95% CI 0.01 to 0.13, $p = 0.012$) older participants (0.002, 95% CI 0.0001 to 0.004, $p = 0.037$)	University degree (.08, 95% CI 0.02 to 0.14, $p = 0.004$)
Goals	None present	None present
Imitation	None present	None present
Impulse management: acceptance	None present	University degree (0.06, 95% CI 0.001 to 0.12, $p = 0.024$)
Impulse management: awareness	None present	None present
Impulse management: distraction	Younger participants (0.001, 95% CI 0.0002 to 0.002, $p = 0.005$) men (0.061, 95% CI 0.02 to 0.10, $p = 0.002$)	Men (0.12, 95% CI 0.06 to 0.18, $p < 0.001$)
Impulse management:	None present	None present
Information	None present	None present
Motivation	Men (0.015, 95% CI 0.001 to 0.034, $p = 0.012$)	Men (0.06, 95% CI 0.001 to 0.12, $p = 0.041$)
Planning	White British/Irish (0.009, 95% CI 0.01 to 0.017, $p = 0.018$)	Men (0.11, 95% CI 0.05 to 0.17, $p < 0.001$)
Allowances	None present	None present
Restrictions	None present	Men (0.08, 95% CI 0.02 to 0.14, $p = 0.002$)
Rule setting	None present	Men (0.10, 95% CI 0.05 to 0.15, $p < 0.001$)
Restraint	None present	None present
Reward	Men (0.17, 95% CI 0.07 to 0.27, $p = 0.001$)	Younger age (0.002, 95% CI 0.0001 to 0.003, $p = 0.031$) men (0.12, 95% CI 0.06 to 0.18, $p < 0.001$)
Scheduling	Men (0.04, 95% CI 0.01 to 0.06, $p = 0.005$)	Men (0.11, 95% CI 0.05 to 0.16, $p < 0.001$)
Self-monitoring	None present	None present
Stimulus control	Men (0.04, 95% CI 0.01 to 0.06, $p = 0.005$)	Men (0.10, 95% CI 0.05 to 0.15, $p < 0.001$)
Support: buddying	University education (negative) (-0.15, 95% CI -0.23 to -0.06, $p = 0.001$)	University education (negative) (-0.07, 95% CI -0.12 to -0.02, $p = 0.003$)
Support: motivational	None present	Men (0.08, 95% CI 0.02 to 0.14, $p = 0.008$)

Domain	Significant association when defined as use of at least one strategy within that domain	Significant association when defined as percentage of strategies used within that domain
Support: professional	University education (negative) (-0.11, 95% CI -0.18 to -0.03, p = 0.004)	Men (0.10, 95% CI 0.02 to 0.19, p = 0.012) White British/Irish (negative) (-0.04, 95% CI -0.07 to -0.004, p = 0.030) university education (negative) (-0.08, 95% CI -0.14 to -0.03, p = 0.002)
Weight management aids	Younger participants (0.004, 95% CI 0.0009 to 0.006, p = 0.009) men (0.16, 95% CI 0.04 to 0.27, p = 0.007)	Younger people (0.001, 95% CI 0.00005 to 0.003, p = 0.041)

4.4.4 Weight at three months

One hundred and ninety-four participants reported their weight at approximately three months from baseline (75 to 105 days) and are used in subsequent analyses testing associations between strategy or domain use and weight. For this measure, the mean days of follow-up was 89.2 (SD 7.1), and the mean weight change was -3.25 kg (SD 4.07).

Compared to all of the participants who began registration, survey completers who provided their weight at three months from baseline were likely to be older (mean age completers with weight data 50.6 years (SE 1.45) versus 47.9 years (SE 0.49), p = 0.02), with no other significant differences in demographic characteristics. There were no significant differences in the demographics measured between survey completers who did not report weight at three months and those who did.

4.4.5 Associations between strategy and domain use and weight

4.4.5.1 Strategies and patterns of strategy use

The total number of strategies used at baseline was not significantly associated with weight at three months, when controlling for baseline weight. Two strategy patterns (see

Table 15) were significantly associated with weight change, with higher factor scores associated with greater weight loss: the dietary impulse control pattern (-0.55 kg, 95% CI -1.08 to -0.03, $p = 0.039$) and the weight loss planning and monitoring pattern (-1.29 kg, 95% CI -2.04 to -0.54, $p = 0.001$).

4.4.5.2 Theoretical model of essential strategies

In the model of essential strategies for weight change, the average score was 5.4 out of 9. Using a continuous model, there was a significant association between score and weight change (-0.43 kg, 95% CI -0.69 to -0.18 kg, $p = 0.001$), as there was using a binary model examining those participants using seven or more strategies most of the time compared to those using six or fewer (-2.13 kg, 95% CI -3.27 to -0.99, $p < 0.001$).

4.4.5.3 Domains

The number of domains used at baseline was not significantly associated with weight change. When defined as using at least one strategy within that domain, only motivational support was significantly associated with weight change (-2.39 kg, 95% CI -4.39 to -0.39, $p = 0.020$). In exploratory analyses for strategies within this domain, one was found to be significantly associated with weight change: “I told other people about my weight loss goals to help me stick to them” (-1.16 kg, 95% CI -2.29 to -0.03, $p = 0.044$). When defining domain use as percentage of strategies used within individual domains, information seeking (-3.93 kg, 95% CI -6.49 to -1.37, $p = 0.003$) and self-monitoring (-2.89 kg, -5.71 to -0.07, $p = 0.045$) were both found to be significantly associated with greater weight loss. Within information seeking, exploratory analyses found that using a book, website or app to look up nutritional information was the only strategy significantly associated with weight change (-1.70 kg, 95% CI -3.02 to -0.38, $p = 0.012$). Within self-monitoring, two strategies were significantly associated with

weight change in univariate models: checking portion sizes (-1.50 kg, 95% CI -2.90 to -0.09, $p = 0.037$) and keeping track of calorie/nutritional content of food consumed (-1.65 kg, 95% CI -2.96 to -0.34, $p = 0.014$). When combined in a multivariate model, keeping track of calorie and/or nutritional content remained significantly associated with greater weight loss (-1.45 kg, 95% CI -2.78 to -0.12, $p = 0.032$).

4.5 Discussion

The OxFAB questionnaire was able to identify a large number of frequently used strategies and detect associations between patterns of strategy use and weight change. This analysis revealed large inter-individual differences in the use of specific strategies and groups of strategies (domains). It has identified associations between the use of strategies relating to dietary impulse control, weight loss planning and monitoring, motivational support, information seeking and self-monitoring and greater weight loss at three months. There were also significant associations between weight change at three months and use of strategies in the theory-driven model of those deemed to be essential for weight change. Together this provides useful insights to guide the development of self-management programmes for weight loss.

As this is the first study using the OxFAB taxonomy, results cannot be directly compared with other studies, though some related work has been done. As discussed in Chapter 1, the US National Weight Control Registry (NWCR) has evaluated a number of behavioural strategies, but focusses on weight loss maintenance, including only people who have maintained a weight loss of greater than 30 lbs for a year or longer, as compared to the OxFAB cohort study which focussed on weight loss.⁽¹⁸²⁾ The profile of OxFAB participants is therefore distinctly different from the NWCR, but there are

important parallels between the findings, including data suggesting the importance of dietary restraint and self-weighing.(90, 92, 183) Outside of cohort studies, results from a large US population based survey pointed to the importance of self-monitoring of food intake, but this was a retrospective survey without validated tools for assessing strategy use, and focussed on maintenance rather than initial loss.(184) In terms of those strategies relating to dietary impulse control, a recent systematic review of techniques for modifying impulsive processes associated with unhealthy eating included 92 studies and found promising changes in unhealthy food consumption and food cravings.(185)

It is clear that further studies are needed to evaluate links between cognitive and behavioural strategies for weight loss and subsequent weight change, particularly in light of some of the limitations inherent in this study. Firstly, the sample used in this study is not representative, which limits the applicability of the findings across a range of population groups. Secondly, by using cross-sectional data, this study is unable to determine causation, and there may be unmeasured variables which account for associations between strategy use and weight change. However, the types of strategies found to be associated with weight change have been found to be successful elsewhere, increasing my confidence that the associations may be causal. A third limitation of this study is its reliance on self-reported data; the accuracy of self-reported weight is a known issue and is a limitation in all studies of this type.(186) In particular, data suggest that people are likely to underestimate their weight when self-reporting. Reassuringly, self-reported and observed weights have been found to be closely correlated. Two large studies comparing web-based self-reported weight and observed weight recently concluded that self-reported weight loss is comparable with observed.(187, 188). In this study, both weight at the start and end were self-reported,

so there is no reason to assume that weight change is biased. In particular, it is unlikely that any bias from self-report weight differs by use or non-use of a particular strategy or group of strategies and therefore data on the association of strategy use and weight change are likely to be valid. A fourth limitation is that only approximately 40% of those eligible participants who began registration completed the questionnaire; this likely reflects the length of the questionnaire, which I will look to reduce in the future (see Chapter 7). A final limitation is that the use of the study website may in itself be considered a strategy to which all participants were exposed, though efforts were made to mitigate the website's role in prompting use of particular strategies.

These are exploratory findings using a novel methodology and the associations need to be evaluated in future confirmatory studies. In the meantime, however, they shed light on an under-researched area, and, when taken as part of the broader research presented in this dissertation, begin to fill in gaps in our knowledge of what people are doing in self-directed weight loss attempts, and how this might be linked with success.

Importantly, this study provides proof-of-concept that the taxonomy and questionnaire developed in Chapter 2 can differentiate strategy use between individuals, and that such differentiation may explain differences in weight loss trajectories. In Chapters 5 and 6, I will consider these strategies in a different light; rather than quantifying, subsequent chapters explore experiences of weight loss through qualitative synthesis techniques.

Chapter 5 Cognitive and behavioural strategies for self-directed weight

loss: systematic review of qualitative studies

5.1 Summary

This chapter reports the methods and an overview of results from a systematic review of qualitative studies which aimed to examine the strategies people employ as part of self-directed weight loss attempts, map these to the OxFAB taxonomy, and explore attitudes and beliefs surrounding these strategies. Seven electronic databases were searched in December 2015 for qualitative studies in adults with overweight or obesity attempting to lose weight through behaviour change. The primary interest was strategies used by participants in self-directed efforts to lose weight. Myself and a second reviewer extracted and coded data from included studies. Thematic and narrative synthesis techniques were used. Thirty-one studies, representing 1,050 participants, were included. Quality of the included studies was mixed. The most commonly covered types of strategies were restrictions, self-monitoring, scheduling, professional support and weight management aids. With the exception of scheduling, for which participant experiences were predominantly positive, participants' attitudes and beliefs surrounding implementation of these groups of strategies were mixed. Data suggested that strategy use changed throughout the course of a weight management attempt. Generally, a wider range of strategies were discussed in relation to weight loss maintenance than in relation to acute weight loss attempts. Two new groups of strategies were added to the OxFAB taxonomy: reframing and self-experimentation.

Note: At the time of submission, a version of this chapter was accepted and in press at *Obesity Reviews*.

5.2 Introduction

To further our understanding of the cognitive and behavioural strategies used by individuals in self-directed weight loss attempts, it is crucial to not only consider frequency of strategy use and associations with weight change (as per Chapter 4) but also to consider the experiences and perspectives of people embarking on self-directed weight loss attempts. Though quantitative methods can tell us about the strategies people are using and how these are associated with weight change, they cannot tell us as much about the complexities behind why people choose to use certain strategies or why they choose not to use certain strategies or to discontinue their use, and indeed may not fully reveal the complexity of the experience of weight loss.(189) It is particularly critical to understand these elements when considering how to provide effective advice to people embarking on weight loss attempts, which is the ultimate aim of this research. The methods used so far in this dissertation also leave a key gap in the development of the taxonomy and questionnaire: namely to explore those strategies that may not be recommended by traditional self-help programmes and to explore the language used to describe these strategies in participants' own voices. Without such exploration, the taxonomy and questionnaire risk being incomplete or misrepresentative.

Accordingly, a logical next step in developing understanding of the cognitive and behavioural strategies used in self-directed weight loss attempts is to examine experiences of strategy use through the lens of qualitative research. To the best of my knowledge, at the time of writing, no systematic reviews of qualitative evidence specific to self-directed weight loss and weight loss maintenance had been conducted. Driven by the need to understand the existing evidence base in order to inform the taxonomy, questionnaire, and future intervention design, I set out to conduct the first review of

qualitative literature in this area. In particular, the review presented in this chapter aimed to:

- examine the strategies people employ as part of self-directed weight loss attempts;
- test the current version of the OxFAB taxonomy against narrative descriptions of weight loss, refining and adding new terms if warranted; and
- explore attitudes and beliefs surrounding the implementation of these strategies as part of self-directed efforts to lose weight.

5.3 Original review plan and deviation

Details of the protocol for this systematic review were registered on PROSPERO prior to work commencing.(190) Though the methods have not changed, the original plan was to write this review as one cohesive analysis. However, the data extraction process yielded greater quantities of richer data than I was initially anticipating (in particular, large amounts of verbatim text from participant interviews available in unpublished dissertations), which greatly exceeded the time available as part of the series of studies comprising this thesis. This led me to alter the analysis plan as outlined below. The new plan has three components.

5.3.1 First component: overview and overarching analysis (contained in this chapter)

The first component is presented in this chapter, which details the methods used, the characteristics of included studies, and how the findings relate to the OxFAB taxonomy. In particular, it covers:

- methods used to conduct the review, including searching, screening, data extraction, and analysis;

- characteristics of all included studies, including participants, setting, study aims, methods, and quality;
- mapping of data onto the existing OxFAB taxonomy – e.g. which domains appear in the included studies and how frequently; and
- expansion of the OxFAB taxonomy through the addition of new domains and strategies, where relevant.

It also describes the context in which strategies were discussed.

5.3.2 Second component: domain-specific papers

Given the complexity and depth of information for some domains, it was judged unfeasible to do one overarching qualitative thematic synthesis encompassing all of the data. Instead, in discussion with my supervisors, I decided to focus on domain-specific analyses for rich areas, forming the second component of the analysis plan. The first of these domain-specific analyses explores self-monitoring, and is presented in Chapter 6.

5.3.3 Third component: database for future projects

Currently, all data extraction forms are stored and coded by domain in an NVivo database. Data collected as part of this review could be used for other analyses in the future, whether domain specific or using a different scope. Hence, I have set up the database in a manner which will allow it to be queried for specific terms to aid future intervention development. It could also be updated through rerunning the searches, if deemed appropriate. My intention is that this database would be available to other researchers upon request, and would be a useful starting point for student projects, in particular.

5.4 Methods for this chapter

5.4.1 Search

Seven electronic databases were systematically searched in December 2015 (CINAHL, EMBASE, MEDLINE, PsycINFO, Science Citation Index Expanded, Social Science Citation Index, Conference Proceedings Citation Index – Science) for qualitative studies using terms related to qualitative research methodologies, obesity, weight loss, diet, exercise, behaviour change and self-care. Search terms for obesity, behaviour change and self-care were adapted from my review of self-help interventions for weight loss (as presented in Chapter 3) (99) and search terms relating to qualitative methodology are those proposed by the Cochrane Collaboration.(191) MEDLINE search terms are listed in full in Appendix 7. I also screened reference lists of included studies and relevant systematic reviews for further studies.

5.4.2 Inclusion criteria

The SPICE framework, used for qualitative evidence synthesis (settings, participants, interest, comparison, evaluation), was used to define inclusion criteria.(192) Settings included community and primary care, and participants included adults (18 years or older) who had attempted or were attempting to lose weight through behaviour change. Studies exclusively in people with anorexia nervosa or bulimia nervosa were excluded. The interest was those strategies used by participants in self-directed efforts to lose weight, defined as identifiable and unique behaviours or cognitions designed to help participants achieve weight loss targets or adhere to diet or physical activity targets explicitly undertaken in an effort to lose weight. Other outcomes were not included. Studies evaluating participants' experiences with, or opinions of, specific weight loss

interventions (e.g. programme evaluations) were also excluded, as the aim of this review was to focus exclusively on self-management, including those strategies used by individuals that may not be advised by standard self-help information or be deemed acceptable in a trial context. Studies were not restricted on the basis of comparisons. Only qualitative studies were included, e.g. interview, semi-structured interview, open-ended surveys, and focus groups. Non-English language articles were excluded. There were no restrictions on publication date or country.

5.4.3 Screening and data extraction

I screened titles and abstracts for inclusion, with a sample of 10% checked by a second reviewer. The agreement rate was 100%. I conducted full text screening; where I was unsure I consulted with a second reviewer. Data extraction was conducted independently by myself and another reviewer for all included studies using an adapted version of the QARI (qualitative report data extraction) form developed by the Joanna Briggs Institute for Evidence Based Practice.(193) The form was piloted before use by myself and another reviewer. Data extraction consisted of three main components: study characteristics (including research aims, methods, setting, and participant details); quality assessment (using the Critical Appraisal Skills Program (CASP) for qualitative studies (194)); and self-management strategies. Discrepancies were resolved by discussion or, where necessary, through referral to a third reviewer.

Myself and a second reviewer independently identified cognitive and behavioural strategies for weight loss in the included studies and coded these against domains from the OxFAB taxonomy (see Chapter 2).(99) Where present, we also extracted data relating to use of self-management strategies more generally, or relating to cognitive and behavioural strategies for weight loss which were not included in the first version of

the OxFAB taxonomy, as an explicit aim of this analysis was to expand the OxFAB taxonomy as needed.

5.4.4 Analysis

Two reviewers (myself and one other) independently inductively and deductively coded data on self-management strategies. Deductive coding involved coding against the pre-established domains from the OxFAB taxonomy; inductive coding was used to capture relevant data not covered by the taxonomy. I then imported coded text from included studies on self-management strategies into NVivo 11.(195) This included both direct quotes from participants as well as authors' summaries and interpretations of data.

Where studies yielded strategies that had not yet been identified in the taxonomy, these were used to expand the coding framework through the addition of new index terms and/or top level categorizations (domains). This analysis was based on the principles of the thematic synthesis approach, set forth by Thomas and Hardern (196) and detailed by Major and Savill-Baden.(197) Thematic synthesis draws on the methods used in thematic analysis of primary sources, extending them for use in systematic reviews. I selected this approach because of its synergies with the taxonomy development process. Thematic synthesis consists of three analytical steps:

1. Identifying and analysing first order themes (through line by line coding);
2. Synthesising second order themes (through organizing free codes into related areas to construct descriptive themes); and
3. Interpretation of third order themes (the development of analytical themes).

To translate this into development of the taxonomy:

1. Identifying strategies not covered by current taxonomy (first order themes);

2. Synthesising new strategies into groups of related strategies (organizing free codes into related areas to construct descriptive themes); and
3. Interpretation of third order themes (creating new domains or adding strategies to existing domains, as appropriate).

I discussed those strategies not covered by the current taxonomy with my supervisors to reach consensus on whether new domains should be formed or whether strategies should be added to existing domains. Other findings are synthesised narratively.

5.5 Results

5.5.1 Search results

Excluding duplicates, searches yielded 2,284 references (see Figure 14). After full text screening, 36 references, representing 31 studies, were included. Of these, six were unpublished theses. The most common reason for exclusion at full text stage was that the study was an evaluation of a specific weight loss programme, rather than focussed on self-directed weight management efforts.

5.5.2 Characteristics of included studies

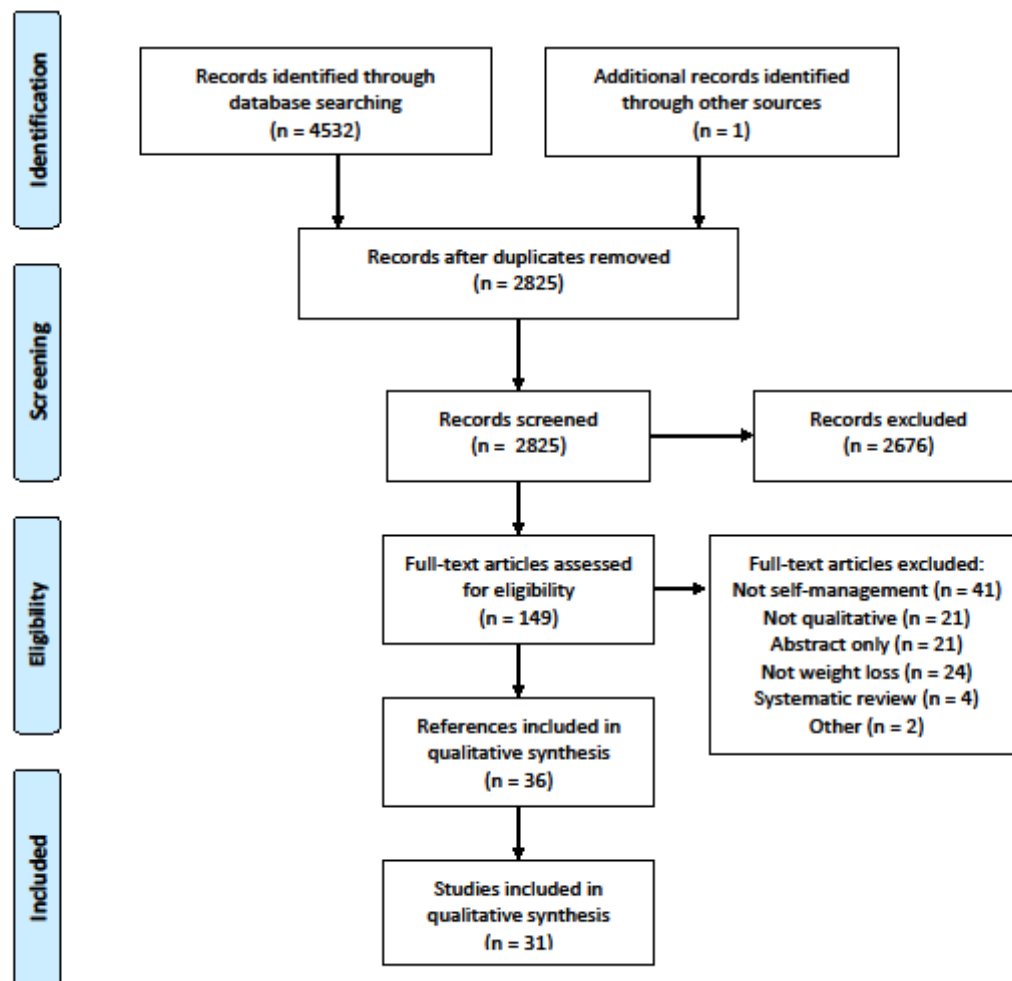
Details on key individual study characteristics can be found in Table 19. An overview is provided below.

5.1.1.1 Methods

Of the 31 included studies, seven used focus groups and 22 used one-to-one interviews, alone or in combination with other methods (Figure 15). Two studies used web content as the basis for analysis: one collected data from a web forum on weight loss linked to a popular male magazine and the other collected data from a weight loss blogging

website, as well as administering qualitative surveys to bloggers. Six studies used a form of phenomenological analysis to analyse data, six used thematic analysis, and eight reported using grounded theory. The remainder did not report their approach.

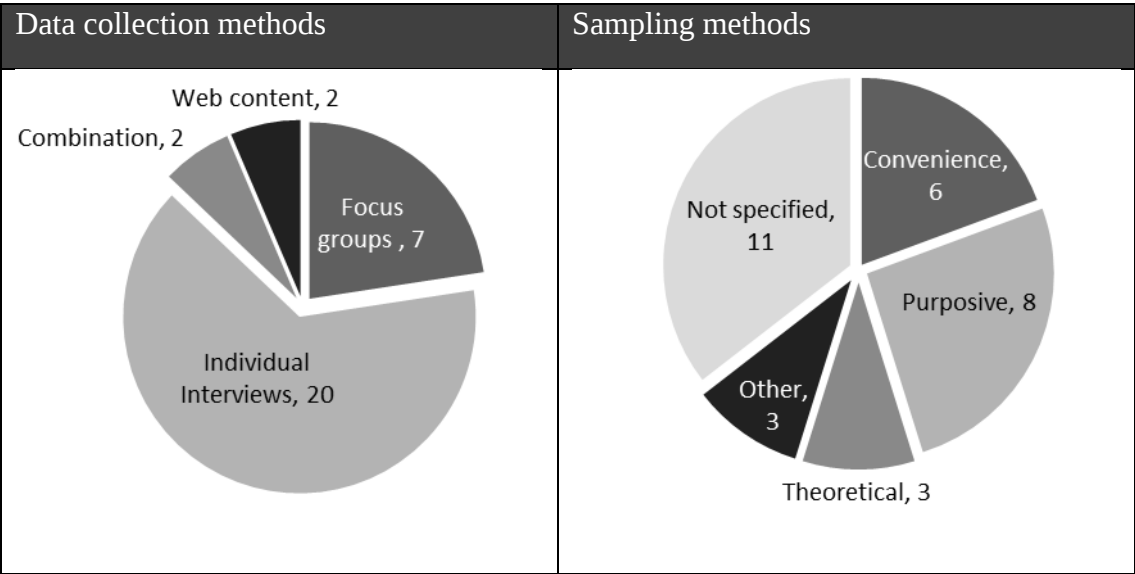
Figure 14 PRISMA diagram of study flow



As shown in Figure 15, 11 of the studies did not report their sampling methods; of those that did, the most commonly used methods were purposive, theoretical, snowball, random, and maximum variation sampling. Few stated the purpose of such sampling, but where reported sampling was conducted to capture either a range of weight loss experiences or to recruit participants from different ethnic backgrounds in relatively

equal measure. Where reported, recruitment was primarily through advertisements in local media, flyers in public places (some targeting gyms and locations where weight loss programmes were offered), by word of mouth, and through personal contacts. Two studies posted flyers in medical centres and one recruited via referrals from a health and wellness centre.

Figure 15 Characteristics of included studies: methods



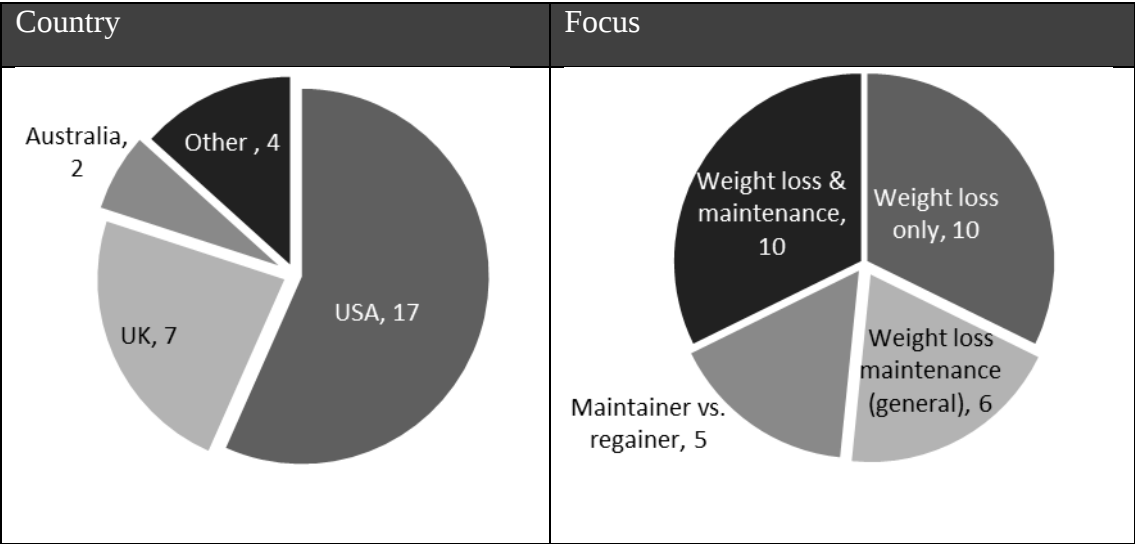
5.1.1.2 Participants

Combined, the included studies represent 1,050 participants. The majority of studies took place in the USA (see Figure 16). Ten studies focussed exclusively on weight loss, and eleven focussed exclusively on weight loss maintenance. Of the latter, five explicitly recruited ‘regainers’ and ‘maintainers’, and focussed on differences between the two (see Figure 16). Seven focussed exclusively on experiences within particular population groups, e.g. by ethnicity or age range.

Across the 21 studies that reported it, the average age of participants was 42. Studies predominantly recruited more women than men. Where reported (11 studies), average BMI across the studies was 31.9 kg/m², ranging from 25.8 kg/m² (study of successful,

weight loss maintainers who were previously obese) to 42.5 kg/m². Of the 18 studies which reported data on ethnicity, 11 represented all or majority white populations. Two included only African-American participants (198, 199), and one included only Latinos.(200) Approximately half of the studies reported data relevant to socioeconomic status; of these, the majority reported including predominantly well-educated participants of middle to high socioeconomic status.

Figure 16 Characteristics of included studies: participants



5.1.1.3 Quality of included studies

The quality of the included studies was mixed, in part reflecting that a proportion of the included studies had not been published in peer reviewed journals (unpublished doctoral theses).(201-206) A summary of answers for each CASP domain is presented in Table 18. Issues were predominantly related to recruitment methods, the relationship between the researcher and participants, and provision of sufficient detail on the method of analysis.

Table 18 Summary of quality judgements

CASP question (194)	Number of answers across all included studies		
	Yes	Unclear	No
Was there a clear statement of the aims of the research?	29	0	2
Is a qualitative methodology appropriate?	30	1	0
Was the research design appropriate to address the aims of the research?	26	3	2
Was the recruitment strategy appropriate to the aims of the research?	13	10	8
Was the data collected in a way that addressed the research issue?	25	5	1
Has the relationship between researcher and participants been adequately considered?	5	18	8
Have ethical issues been taken into consideration?	15	14	2
Was the data analysis sufficiently rigorous?	12	10	9
Is there a clear statement of findings?	16	10	5
Is the research valuable?	24	6	1

Table 19 Characteristics of included studies¹⁰

Study ID ¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity ¹²
Abolhassani 2012* (207)	Iran	Barriers and facilitators to weight gain and loss	Wanting to lose weight, tried to lose weight at least once. Excl. dialect/ language differences, limitations/inability to speak	11	NS	NS	NS	8 employed, no other detail provided	NS
Ali 2010 (208)	United Arab Emirates (UAE)	Weight management behaviours and perceptions of women at increased risk of type 2 DM within UAE cultural context	Emirati national women, 18 or older, no previous DM diagnosis (except gestational), with one or more of: gestational DM; abdominal obesity (weight circumference >88 cm) and family history of type 2 DM; or prediabetes (fasting plasma glucose or glucose load test)	75	39	100	NS	NS	NS
Allan 1991* (209)	USA	Weight management in white women	Normal weight to moderate obesity (40-100% over ideal weight); born in US and living in study area; 18-55 years old; white	37	33.7	100	NS	57% middle class, 43% working class; all but 3 employed. 30% HS grad, 32% some college, 38% college grad	White

¹⁰ DM: diabetes mellitus; Excl.: excluded; grad: graduate; HS: high school; m: month; NS: not specified; SES: socioeconomic status; WL: weight loss; WLM: weight loss maintenance; y: year.

¹¹ Studies also included in the analysis presented in Chapter 6 are indicated by an asterisk (*)

¹² Terms used to describe ethnicity are those used in individual study reports.

Study ID ¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity ¹²
Barnes 2007* (199)	USA	WLM as it relates to the theory of planned behaviour	African American women, aged ≥ 18 , lost $\geq 10\%$ of body weight and either regained or maintained for a year	37	41.6	100	32.75	84% employed Highest level of education: HS 22% regainers (R), 0 maintainers (M); Some college 29% M, 48% R; College grad 50% M, 22% R; Grad school 21% M, 8% R	African American
Befort 2008 (198)	USA	Perceptions and beliefs about body size, weight and WL among obese African American women	Aged ≥ 18 , African American, female, obese according to self-reported weight and height. Excl. obvious intoxication or current inpatient for substance abuse treatment, marked inappropriate affect or behaviour, acute illness or impaired cognition	62	46.6	100	40.3	15% some HS; 21% HS grad; 63% some college; 2% college grad 50% full time employed; 8% part time; 42% not employed	African American
Bennett 2013* (210)	UK	How men communicate with each other about their bodies, weight management projects and masculinities	NS	116	NS	0	NS	NS	NS

Study ID ¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity ¹²
Bidgood 2005* (211)	UK	Obese adults' experiences and feelings about WL attempts and maintenance	Obese men and women ≥ 18 , BMI ≥ 30	18	NS	89	NS	NS	NS
Byrne 2003* (212)	UK	Psychological factors associated with successful and unsuccessful WLM	Female, aged 20-60, history of BMI > 29.9 who at some point in last 2y lost $\geq 10\%$ weight through deliberate caloric restriction. Maintainers: maintained lower weight (within 3.2 kg) for ≥ 1 y. Regainers: Regained to within 3.2 kg of original weight. Excl. WL due to medical/ psychiatric condition or use of medication; WL or regain due to pregnancy or childbirth; history of anorexia or bulimia	56	41	100	NS	Social class 1-2 47%; 3nm-3m 30%; 4-5 1% students 13%; housewives 7%; unemployed 1%	NS
Callen 2008 (213)	USA	Weight change in older adults, focussing on methods	Community dwelling, ≥ 80 , "cognitively intact or mild intellectual impairment", English speaking, BMI ≥ 27 , able to stand for height and weight	9	82	33	30.17	Education range 8th grade to postgrad. 2 had incomes below poverty level	NS ("lack of ethnic representation")

Study ID¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity¹²
Chambers 2012* (214)	UK	Long term weight maintenance	30 or older, wide range of weight experiences. Excl. factors that could impact directly on current weight (pregnancy, some medications, medical conditions, anorexia)	14	48	75	NS	NS	Caucasian
Chang 2008 (215)	USA	Motivators and barriers to healthful eating and physical activity among low-income overweight/obese non-Hispanic black and white mothers	Women, non-Hispanic white or non-Hispanic black, 18-35 years old, not pregnant or breastfeeding, able to speak and read English, BMI 25–39.9, interested in prevention of weight gain, ≥ 3 months postpartum, ≥ 1 child enrolled in government food and nutrition service programme	80	25.8	100	31.15	Highest level of education obtained: 47% HS or less	41 non-Hispanic black; 39 non-Hispanic white
Collins 2012* (201)	USA	Perceptions of previously obese individuals after self-guided WL	Female, aged 35-60, self-identified as ‘obese-reduced weight maintainers’ of $\geq 10\%$ of original weight for ≥ 1 year	11	45.6	100	NS	NS	NS
Davis 2014* (202)	USA	Experiences of college students in the WL process	Full time students at one Midwestern university considered overweight at some point during college enrolment, active in trying to lose weight for ≥ 6 m, willing to be interviewed, 18 or older	5	NS	60	NS	NS	4 Caucasian 1 person of colour

Study ID¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity¹²
Diaz 2007 (200)	USA	WL experiences, attitudes and barriers in overweight Latino adults	Age ≥ 20 , BMI ≥ 25 , self-identified Latino	21	NS	90	NS	5 had education beyond high school	Self-identified Latinos
Faw 2014 (216)	USA	Support management strategies used by overweight young adults attempting to lose weight	Perceive themselves as being overweight or obese, attempted to lose weight at least once during past year (all undergraduate university students)	25	21.1	64	27.1	NS	Asian/Asian American 44%; white 40%
Frank 2012 (203)	USA	WLM	History of weight cycling; highest ever BMI ≥ 30 ; maintained loss reflects BMI of 18.5-24.9; WL achieved without bariatric surgery and maintained for ≥ 3 y; American born and raised	10	NS	90	NS	2 some college; 3 completed college; 5 college + advanced degree	8 Caucasian 1 Latina 1 biracial
Green 2009* (217)	UK	Phenomenology of repeated diet failure	Aged >18 , speak fluent English, ≥ 2 serious attempts to diet which they considered had failed, unhappy with current eating habits. Excl. eating disorder or medical/ psychological input re: eating	11	40	82	NS	NS	1 British Pakistani; 10 white British

Study ID¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity¹²
Heading 2008* (218)	Australia	Risk logics, embodiment, issues related to adult obesity in remote New South Wales	“rural adults”, “history of unwanted weight”	19	NS	68	NS	education ranged from some HS to postgraduate qualifications	NS
Hindle 2011* (219)	UK	Experiences, perceptions and feelings of WLM	Maintained $\geq 10\%$ WL for ≥ 1 year, stable weight for last 6m, 18 or older and English speaking. Excl. WL through bariatric surgery, very low calorie diets, within 6m of giving birth	10	44	100	25.8	“employed, retired or housewives with employed partners”	Caucasian
Hwang 2010* (220)	USA	Social support for WL in web community	Members of SparkPeople.com online WL community	13	36	100	NS	NS	White
Jaksa 2011* (204)	USA	Experience of maintaining substantial WL	Maintained WL for ≥ 2 years; lost $\geq 20\%$ body weight; within 10-15 lbs of their goal weight; willing to commit to reflecting on their experience through an audiorecorded interview; not undergone any surgical procedures affecting or manipulating appetite regulation; aged ≥ 20	12	NS	92	NS	4 grad students; 5 full time employed; 1 part time employed; 1 stay at home mother; 1 on long term disability	NS

Study ID ¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity ¹²
Karfopoulou 2013* (221)	Greece	WLM and Mediterranean diets	20–65 years old, at some point in their lives BMI>25 (excl. pregnancy), intentionally lost ≥10% of starting weight. Maintainers had to be at or below the 10% WL for ≥1 year, regainers had to be at a weight ≥95% of their starting weight. Excl. history of anorexia	44	33	59	27.65	NS	NS
Macchi 2007* (205)	USA	Process of meaning-making associated with WL and maintenance	Female, aged 30-45 when initially lost weight, intentionally lost ≥10% of initial body weight without undergoing bariatric surgery and maintained ≥10% lost	10	NS	100	NS	NS	White
McKee 2013* (222)	UK	WLM	Previous BMI ≥25, intentionally lost 10% through diet and/or exercise and maintained for ≥12 months within range of 2.2 kg or regained weight lost	18	45	89	28.3	Non-academic university staff, self-employed, retired members of the public	10 British 5 South Asian 3 other
Reyes 2012* (223)	USA	WLM	25-64 years old, intentionally lost ≥10% weight in past 2y; regainers regained ≥33% of their WL and maintainers regained ≤15%. Excl. participants with type 2 DM, history of cancer, bariatric surgery	29	47	65.6	32.5	NS	41% white 59% African American

Study ID ¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity ¹²
Sanford 2012* (224)	US, UK, Canada	WL blogs	Need to lose ≥ 100 lbs (not clear how this was defined), had been blogging for ≥ 3 m about WL. Excl. bariatric or lap band surgery	50	40	80	NS	NS	NS
Stuckey 2011* (225)	USA	Successful WLM practices	Lost ≥ 30 lbs and maintained for ≥ 1 year, age > 21 , not pregnant, English speaking. Excl. bariatric surgery	61	NS	72	NS	90% at least some college	79% white
Su 2015* (226)	Taiwan	Taiwanese peri-menopausal women's WL experience	Women aged 45–60, undergoing perimenopause (self-report); BMI ≥ 27 ; trying to lose weight; could communicate in Mandarin and Taiwanese; met diagnostic criteria for metabolic syndrome for Asian populations (> 3 of (1) waist circumference ≥ 80 cm, (2) fasting blood glucose ≥ 100 mg/dl, (3) high-density cholesterol < 50 mg/dl, (4) triglycerides ≥ 150 mg/dl, (5) systolic pressure ≥ 130 mmHg or diastolic ≥ 85 mmHg)	18	52	100	32.6	5 housewives, 13 employed. 7 had attended university	NS
Thomas 2008 (227)	Australia	Lived experiences of obesity and weight loss attempts	BMI ≥ 30	76	47	83	42.5	51% unemployed 45% at least completed HS	80% White Australian 5% English 20% Other European

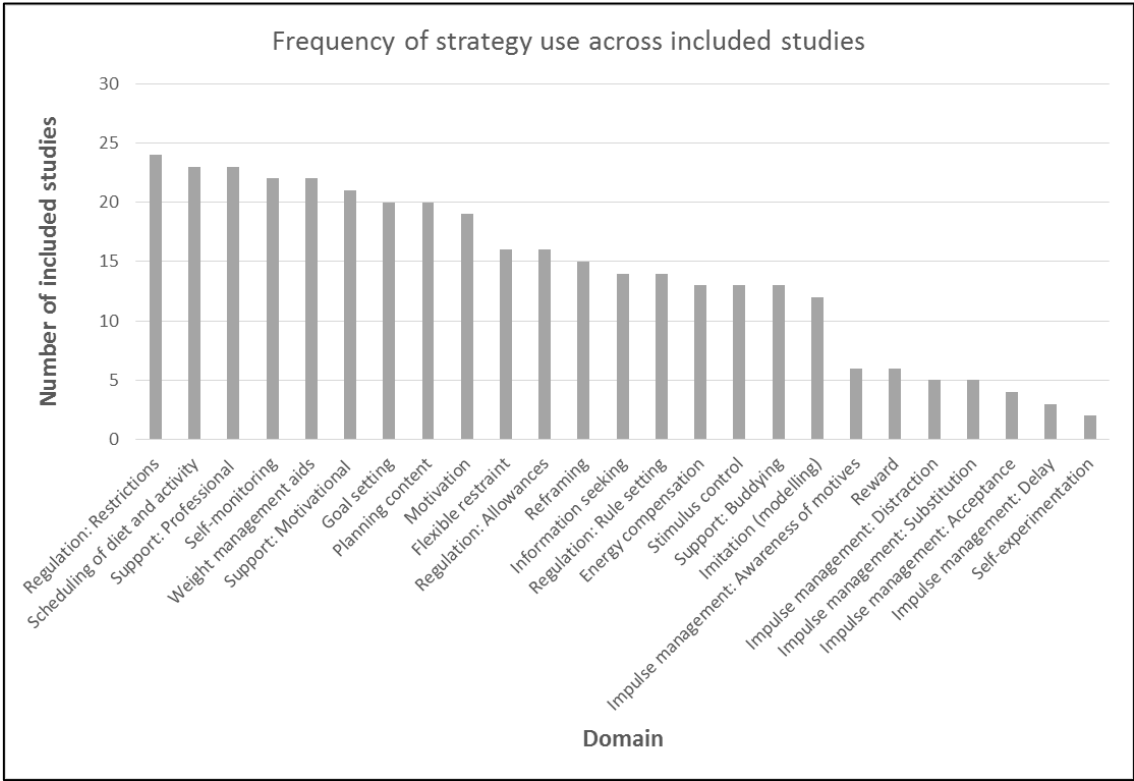
Study ID¹¹	Country	Focus	Inclusion criteria	N	Mean age	% female	mean BMI	SES	Ethnicity¹²
Tyler 1997* (228)	USA	WL methods among women	Female, 18-60 without major health problems, not pregnant, US born, living in study area, normal or overweight BMI	80	34	100	NS	50% higher SES (Hollingshead index 40-66); 50% lower SES (8-39). 26 HS or less; 28 partial college; 13 college grad; 12 grad degree	40 African American 40 Euro American
Witwer 2014* (206)	USA	WLM	Adult (18 or older), lost $\geq 10\%$ of body weight and maintained loss for ≥ 1 y, excl. bariatric surgery, unintentional WL, residents of long-term care settings, non-English speakers	12	NS	66	NS	3 some college, 9 college degree 9 full time employed, 2 part time, 1 retired	NS

5.5.3 Cognitive and behavioural strategies

5.1.1.4 Strategies employed in weight loss attempts

The most commonly coded strategy domains were restrictions, scheduling of diet and activity, self-monitoring, professional support, and use of weight management aids (each occurring in more than two-thirds of the included studies, see Figure 17).

Figure 17 Frequency of strategy coding across included studies (using OxFAB taxonomy)¹³



For each of the most commonly discussed groups of strategies, content predominantly related directly to dietary change. For restrictions, this included avoiding certain foods, particularly energy-dense, high fat, and high sugar items. Participants spoke of cutting out specific foods, rather than groups of foods (e.g. gravy (209), wine (214)). They also

¹³ Self-experimentation and reframing are new domains introduced as part of this review. They are discussed further in ‘Mapping and expansion of OxFAB taxonomy’ (section 5.1.1.5)

mentioned meal skipping and portion control methods, and spoke of avoiding certain settings as a way to restrict access to food, including restaurants and family gatherings.(204, 206, 216) Feelings of deprivation arising from restrictions, which could lead to participants “falling off the wagon” were identified.(203, 219, 222, 223) In one paper of weight loss maintainers, authors noted that participants “avoided banning any foods from their diet as this had, in the past, led to feelings of being deprived, which inevitably made the food more desirable.”(219)

In regards to scheduling, the most commonly occurring strategies related to scheduling meals (most commonly three meals a day at fixed times – e.g. breakfast, lunch and dinner rather than unscheduled snacking)(206, 209, 221, 225) and the practice of not eating late at night or only eating specific foods after a certain time in the evening.(226, 228) Studies also reported participants’ efforts to schedule physical activity at a time that fit with their lifestyles and preferences, including exercising at times where fewer people were present to avoid feelings of embarrassment.(211) One study conducted exclusively with African American women discussed the importance of scheduling time for hairstyle maintenance after exercise.(199)

Self-monitoring strategies most commonly focussed on self-weighing and monitoring food intake, specifically calories. Some participants also monitored fitness, either in terms of time, distance, steps, or calories burnt. In addition to weighing themselves, participants discussed other ways of monitoring their weight, including visual inspection in a mirror (209, 210, 212, 221), the fit of clothing (199, 209, 214, 218), and physical capabilities (e.g. climbing stairs, reaching one’s toes).(201, 214, 223) Negative aspects of the practice of self-monitoring included difficulties with maintaining vigilance over the long term and feelings of shame generated by self-weighing and

monitoring of food intake.(201, 211, 214) In contrast, other studies portrayed a more positive take on self-monitoring, asserting that it led to increased feelings of self-efficacy and self-control, as well as increased accountability for one's own actions.(204, 219, 222, 224) In one study, a participant went so far as to call the weighing scale his "best friend."(223) Self-monitoring is explored further in Chapter 6.

Finally, use of professional support and weight management aids were frequently discussed. Studies often included participants who had formerly attended weight loss programmes, and those who had solicited help from personal trainers, doctors, and nutritionists. Negative experiences were commonly referred to, including advice that did not fit with participants' daily routines (207, 208), experiences of relapse when the support was no longer available (201, 222), and the financial costs of accessing such support.(202, 223, 227) Positives included motivational support and accountability (202, 219) and access to trusted information.(200, 202) The latter particularly pertained to personal trainers who helped with exercise regimes, rather than information on diet. The weight management aids most commonly discussed were medications and over-the-counter supplements, followed by exercise equipment. In a study of Emirati women, participants spoke positively of these aids as a way to overcome cultural barriers to weight loss, which included norms surrounding physical activity and cooking for guests.(208) Other studies noted negative views towards weight loss medications specifically, with participants referring to them as "unnatural" (198, 201) and expressing concerns about side effects and weight regain once medication was discontinued.(227) In one study, participants referred to weight loss medications as "Band-Aids", implying that they were a temporary fix to a problem requiring greater intervention.(201)

5.1.1.5 Mapping and expansion of OxFAB taxonomy

All OxFAB domains were covered in multiple publications, ranging from three (impulse management domains) to 24 times (regulation: restrictions) (Figure 17). In addition to the domains covered above, this review identified two domains which were not covered in the first version of the OxFAB taxonomy, namely reframing and self-experimentation.

Self-experimentation, a recognized technique in behaviour change interventions, refers to the process of experimenting with different techniques and behaviours, assessing their outcomes, and deciding whether or not to continue based on the observed outcome.(94) Studies described this as the mechanism by which participants chose a ‘primary strategy’ to use in a weight loss attempt (201, 209), using ‘self-analysis’ to create eating and exercise plans.(205, 228) One participant, from a study of female weight loss maintainers, explained:

“In the beginning it was routine. ‘This is the routine. This is what you set out for yourself and, lo and behold, you’re making successes.’ Then it became, in my mind, an analysis of why it was successful and how to keep it going.”(205)

Reframing refers to the process of redefining the behaviours and process of weight loss, shifting from “diet” terminology to thinking about weight loss behaviours as “a way of life.”(202, 203, 205, 206, 221) This included participant statements such as: “it’s not a diet... I try hardly ever to say that word. .. Because it’s gotta be lifestyle” (203); “I went with the belief that this wasn’t a diet, but what I’d got to do was change my way of eating” (218); and, “you’ve got to tell yourself you’re not on a diet you’re just changing your way of life.”(222) In other studies, participants used specific metaphors as a way

of reframing, re-envisioning food as “fuel”, “drugs” or “poison”(204), and hunger pangs as “Pac Men [video game animations] eating away... at fat”.(225)

In addition to the above new domains, impulse management domains were expanded to include delay (responding to an unwanted impulse by delaying the desired action (204, 226, 228)) and substitution (using a physical substitution for eating, for example, chewing gum (200, 204, 206, 221, 225, 228)). Strategies falling under these domains had previously been present in the OxFAB taxonomy but were classified as ‘impulse management: distraction’; it was agreed in the process of coding data from this review that these did not fit in this domain and the taxonomy was hence refined accordingly.

5.1.1.6 Implementation of strategies

In addition to covering specific strategies, there was also some reflection on the ways in which participants selected and implemented the strategies they would use, though generally this was limited. In Chambers 2012, which explored differences between ‘regainers’ and ‘maintainers’, the authors state that maintainers spoke of having a number of strategies they could employ when seeking to manage their weight, and contrasted this with regainers who usually attempted to lose weight “via a single strategy”, most commonly relating to restrictions.(214) Tyler 1997 observed that, though participants experimented with a number of different strategies for weight loss, they usually had a preferred method to which they repeatedly turned. The most common ‘primary weight loss methods’ identified by the authors were reducing high calorie foods (restrictions by the OxFAB definition), increasing the intake of low calorie food (allowances by the OxFAB definition), and exercising on one’s own.(228) Faw 2014 focussed exclusively on methods relating to social support and found clusters of strategies, with some participants favouring direct approaches (e.g. directly soliciting

support, confronting those who did not offer it) and others using a variety of indirect methods (e.g. complaining as a way to elicit support, avoiding people who did not offer support). The author labels this the 'direct/indirect strategy continuum'.(216)

Other studies reflected how strategy choices changed over time. Collins 2012 reported that the strategies selected by participants were 'unique' depending on the participant and changed over time through the process of self-experimentation.(201) Allan 1991 divided the weight management process into stages (appraising, de-emphasising, mobilising, enacting and maintaining) and noted that each stage consisted of multiple processes which were characterised by the use of specific tactics or strategies. The complexity of these strategies and tactics increased with each stage of the process.(209) Thomas 2008 noted a similar pattern of progression through strategy type in their participants: participants began by looking up and following diets they found in magazines as teenagers (information seeking by the OxFAB definition), then moved on to behavioural weight management programmes (professional support by the OxFAB definition), and then turned to medications and diet supplements (weight management aids by the OxFAB definition).(227)

Differences in strategy use over time can also be observed through comparing those studies conducted exclusively in people attempting to achieve initial weight loss versus those conducted exclusively in people attempting to maintain weight loss. Generally, a wider range of strategies were discussed in relation to weight loss maintenance than in relation to acute weight loss attempts. Though mention of some domains was similar across both groups of participants, discussions of weight loss maintenance more frequently focussed on flexible restraint, goal setting, impulse management: awareness of motives, motivation, planning content, rule setting, self-monitoring and stimulus

control than those discussions focussing on weight loss only. In contrast, those studies focussing on weight loss only included more discussion of imitation (modelling) strategies.

5.6 Discussion

5.6.1 Summary of main findings

People who are trying to lose weight through self-directed means describe restrictions, self-monitoring, scheduling, professional support and weight management aids as their dominant weight loss strategies. With the exception of scheduling, for which participant experiences were predominantly positive, participants' attitudes and beliefs surrounding implementation of these strategies were mixed. Overall, a wider range of strategies were discussed in relation to weight loss maintenance than to weight loss itself. All domains in the OxFAB taxonomy were covered by multiple included studies. The process of inductive coding in this review led to the expansion of the OxFAB taxonomy, with two new domains added, namely reframing and self-experimentation.

5.6.2 Comparison with other research in this area

To the best of my knowledge, this is the first systematic review of qualitative studies to examine self-directed weight loss efforts. Other qualitative reviews of weight loss in adults with overweight or obesity have included studies focussing on participant experiences of particular weight loss programmes, and therefore excluded experiences of self-directed weight loss.(229-232)

In terms of the strategies covered, it is unsurprising that dietary restrictions and self-monitoring were frequently the focus of the studies included in this review. Many weight loss interventions include these components (68, 69) and observational studies

have linked them with improved weight loss and maintenance trajectories.(90, 92, 183) In contrast, the other commonly mentioned strategies emerging from this review are less evident in interventions: in my systematic review of self-help interventions for weight loss (Chapter 3), only six of the 39 interventions recommended scheduling of diet and physical activity, and only two recommended weight management aids.(69) These results suggest that the strategies people are using in self-directed weight loss attempts do not always mirror those recommended by self-help interventions. As with the participant experiences described in this chapter, the majority of the OxFAB cohort were also employing scheduling techniques and weight management aids as part of their weight loss attempts (see Chapter 4). Further research into the potential disconnect between what is recommended in intervention programmes and what individuals choose to do is warranted.

5.6.3 Limitations

A major limitation of this review is the scope and quality of the included studies. Though some were high quality, quality assessment raised issues for many of the studies, and a number of the included studies were unpublished theses. The majority of studies were undertaken in the US (17 studies) and UK (7 studies), and the vast majority were undertaken in the developed world among participants of higher socioeconomic status. Given cultural variation in strategies used and barriers to self-directed weight loss which represent an unequal burden on people from lower socioeconomic groups (see Chapter 3), further studies in more diverse populations are needed.

In addition, few of the included studies focussed explicitly on weight loss strategies. Given the nature of the available data, it is difficult to determine if the content of the studies accurately reflect the experiences of the participants, or if the studies' results

have been tailored based on the interests of the researchers. Despite this, the studies still yielded rich data on weight loss strategies, pointing to the prominence of techniques and methods in participants' accounts of their own weight loss experiences.

5.6.4 Areas for future research

A fuller understanding of the cognitive and behavioural strategies used in self-directed weight loss efforts has the potential to inform new approaches to weight management programmes and enrich the advice provided to individuals trying to lose weight on their own. Further high quality primary studies are needed to explore experiences of self-directed weight loss in adults with overweight or obesity, with a particular focus how people choose and implement cognitive and behavioural strategies and how these relate to one another, e.g. as a coherent package or as unrelated elements. Further understanding of strategy use within key domains is also warranted; as illustrated in Faw's study of social support, honing in on particular groups of strategies may allow richer connections to be drawn.⁽²¹⁶⁾ This review provides a potential starting point to facilitate such analyses; as described in section 5.3.3, the NVivo project file could serve as a database which could be regularly updated and available for other researchers to access upon request, allowing for domain-specific syntheses to be conducted, enabling richer and more detailed analysis than was possible in this overview. The first of these domain-specific syntheses is presented in Chapter 6, which explores self-monitoring.

Chapter 6 Experiences of self-monitoring in self-directed weight loss and weight loss maintenance: systematic review of qualitative studies

6.1 Summary

This chapter presents an analysis exploring the different forms and roles self-monitoring takes within self-directed weight loss efforts and mechanisms through which these differences may impact or be impacted by weight change trajectories. Data were collected as part of the review presented in Chapter 5 but here I conduct a richer and more in-depth analysis than was possible in Chapter 5. Studies were only included in this analysis if they contained some information on self-monitoring strategies – in practice, this resulted in 22 of the 31 studies from Chapter 5 being included in this domain-specific analysis, representing 681 participants. Thematic synthesis was used to construct descriptive and analytical themes from the available data, drawing on both inductive and deductive approaches. Self-monitoring was experienced and enacted in a variety of ways, which differed between individuals and included interlinking analytical themes relating to self-perception and emotions, attentive and reactive self-monitoring, and trust and deception. Self-monitoring has the ability to both reward and rebuke users, and data from this review show both emotional forces can foster motivation to continue weight management efforts. However, feelings of shame were linked with abandonment of efforts. Data from this chapter suggest that explicitly framing self-monitoring as a positive tool with which to aid self-analysis may go some way to encourage ongoing use of this technique.

Note: At the time of submission, a version of this analysis was under review at *Social Science & Medicine*.

6.2 Introduction

As discussed in Chapter 5, the systematic review of qualitative studies of self-directed weight loss yielded greater quantities of richer data than I was anticipating, in particular due to large amounts of verbatim text from participant interviews. The analysis plan was therefore revised to contain multiple components; Chapter 5 presents an overview and overarching analysis of the review, whereas this chapter presents a domain-specific analysis of data on self-monitoring, defined as the procedure by which individuals record their own target behaviours.(233)

Self-monitoring was chosen as the area of interest for this chapter for two reasons: firstly, a large amount of data on self-monitoring was available from the included studies, and secondly, self-monitoring is a technique that has received much attention in weight management research and interventions. Indeed, self-monitoring is often described as a central component of behavioural treatment for weight loss (234); within this context it may include monitoring dietary intake, physical activity, and outcomes including weight, size, body shape, and/or physical fitness measures.(99) The ubiquity of self-monitoring in weight loss interventions has been highlighted by systematic reviews.(68, 69) In the systematic review of behavioural weight management programmes that I conducted on behalf of NICE, all but one of the 40 interventions evaluated recommended participants record their food intake and/or physical activity, and three-quarters prompted self-weighing.(68) Similarly, in the review of self-help interventions for weight loss (Chapter 3), 36 of 39 interventions included some degree of self-monitoring.(69) Findings from Chapter 4 and elsewhere also suggest self-monitoring is commonly used by people trying to lose weight on their own, without support from an intervention or health professional.(85) The experience and role of self-

monitoring in this context, however, may be distinctly different from that of self-monitoring within the framework of a formal intervention. In particular, it has been suggested that external accountability may increase the effectiveness of self-monitoring; self-monitoring as part of self-guided weight loss and outside of a formal intervention may lack this added element.(235)

Self-monitoring has long been conceptualised as a central agent of behaviour change, and has been found to lead to decreases in unwanted behaviours and increases in desired behaviours in a number of areas, including diet and physical activity.(90, 236-239)

Multiple explanations have been offered as to how and why self-monitoring works in this capacity. One theory is that self-monitoring works through bringing habitual behaviour into conscious awareness.(240) As habitual behaviour is often ‘automatic,’ execution of the behaviour is often at least partially unconscious.(241) According to self-regulation theory, self-monitoring also precedes evaluation of progress towards one’s goal or goals, and reinforces the progress made. Kanfer has described several stages of self-regulation in this context: deliberate monitoring of one’s own behaviour (e.g. food intake, physical activity); evaluation of the way in which the behaviour affects health (e.g. impact on weight); and two possible outcomes of this evaluation – if the desired effect is not realised (e.g. weight gain), the person changes their behaviour, and if the desired effect is realised (e.g. weight loss) the person reinforces the effect by continuing the behaviour.(242) In practice, studies have found that self-monitoring facilitates weight loss for some people and not for others, suggesting there may be multiple mechanisms at play.(235) Self-tracking has become an area of increased interest of late, stemming from a rise in the availability and use of technologies to monitor and log personal data. This movement is commonly referred to as the

‘Quantified Self’. Work from Lupton on this topic has highlighted the role of self-tracking in facilitating self-analysis in some individuals, and of particular relevance to this paper, has drawn on the work of Foucault to explore the interplay between societal constructs of ‘good citizenship’, morality, and self-knowledge.(243)

Despite the number of adults trying to lose weight without professional support (Chapter 1) and the apparent frequency of self-monitoring within this population (Chapter 4), little research has explored the role of self-monitoring in self-directed weight loss attempts, particularly in light of its varying effectiveness across individuals. In this chapter, I further analyse results from the systematic review introduced in Chapter 5, focussing on the different forms and roles self-monitoring takes within self-directed weight management attempts and mechanisms through which these differences may interact with weight change trajectories. I finish by viewing the results through the lens of both self-regulation theory and newer findings related to the Quantified Self movement.

6.3 Methods

Screening and data extraction followed the methods set out in Chapter 5. However, to be included in this analysis studies must have contained content relating to self-monitoring strategies (i.e. been coded for use of strategies within the OxFAB ‘self-monitoring’ domain during data extraction).

Analysis followed the thematic synthesis approach, set forth by Thomas and Hardern (196) and detailed by Major and Savill-Baden.(197) As outlined in Chapter 5, thematic synthesis draws on the methods used in thematic analysis of primary sources, extending them to use in systematic reviews, and consists of three analytical steps, namely:

identifying and analysing first order themes (through line by line coding); synthesising second order themes (through organizing free codes into related areas to construct descriptive themes); and interpretation of third order themes (the development of analytical themes). Data were entered into NVivo11.(195) I led the analysis, with discussion with my supervisors and the second coder from Chapter 5 to agree on codes, synthesis and interpretation of themes. A mix of inductive and deductive approaches were used: first and second order themes were identified and analysed using an inductive approach, with an open coding framework used and new themes gathered from the data as they emerged; and interpretation of third order themes was aided by analysing inductively-derived themes through the lens of both self-regulation theory and societal constructs of self-tracking.(242, 243)

6.4 Results

6.4.1 Characteristics of included studies

Of the 31 studies identified in the initial review (Chapter 5), 22 included some discussion of self-monitoring and are included in this analysis, representing 681 participants. Of note, the nine studies that were in scope for all other inclusion criteria but did not discuss self-monitoring tended to include participants of lower socio-economic status and non-Caucasian populations, and tended to focus exclusively on weight loss. Key characteristics of the included studies are contained in Table 19 (Chapter 5); those studies included in this analysis are indicated by use of an asterisk (*) in the 'Study ID' column.

Overall, and as with Chapter 5, study populations were largely homogenous. Where reported, the mean age of study participants was 41 (compared to 42 in Chapter 5), with

the mean age of participants in included studies ranging from 33 to 47. The majority of studies consisted predominantly of women (mean percentage female 82%). In the studies that reported it, the mean BMI was 29.9 kg/m² – this was slightly lower than that in Chapter 5 (31.9 kg/m²). All but four studies were conducted in the USA or UK, with one each conducted in Australia (218), Greece (221), Iran (207) and Taiwan (226). Few studies reported data on socio-economic status or ethnicity; in those that did, populations were predominantly white and of higher socio-economic status.

In terms of the focus of studies, five focussed exclusively on weight loss, and 10 focussed exclusively on weight loss maintenance. The remainder were broader in focus, examining both weight loss and weight loss maintenance processes. All included studies focussed on something broader or different from self-monitoring, and hence the majority of data from which relevant themes emerged were from verbatim participant quotes. Where data were collected from author summaries or analyses, this is explicitly noted.

Quality was mixed across the included studies and followed the same patterns found in Chapter 5 (see Table 18 and Table 20).

Table 20 Summary of quality judgements for subset of studies in self-monitoring analysis

CASP question	Number of answers across all included studies		
	Yes	Unclear	No
Was there a clear statement of the aims of the research?	21	0	1
Is a qualitative methodology appropriate?	21	1	0
Was the research design appropriate to address the aims of the research?	17	4	1
Was the recruitment strategy appropriate to the aims of the research?	12	6	4
Was the data collected in a way that addressed the research issue?	17	4	1
Has the relationship between researcher and participants been adequately considered?	5	14	3
Have ethical issues been taken into consideration?	13	8	1
Was the data analysis sufficiently rigorous?	9	8	5
Is there a clear statement of findings?	10	9	3
Is the research valuable?	18	3	1

6.4.2 Behaviours and outcomes being monitored

As outlined in Chapter 5, the elements being monitored by participants varied, but most commonly involved food intake (e.g. calorie or point-based system, portion size, nutrient profile) and weight as measured on a weighing scale. Other behaviours monitored included physical activity (e.g. steps per day) and water intake. Other outcome measurements included visual inspection (e.g. looking in a mirror), clothing size, fit of clothing, body fat percentage, and physical fitness measures (e.g. heart rate). Some participants also reported monitoring and recording their emotions and internal states (e.g. energy levels).

6.4.3 Analytical themes

Three main analytical themes emerged: self-perception and emotions; attentive and reactive self-monitoring; and trust and deception. These are discussed further below, both individually and in relation to one another.

6.4.3.1 *Self-perception and emotions*

Whether it be a food diary, scale, or fitness measure, the process of self-monitoring and the feedback individuals received from their self-monitoring often gave rise to powerful emotions closely linked with perception of self. This included concepts of ownership of one's own actions and self-knowledge (often associated with positive emotions), feelings of fear and shame, and self-selection of monitoring based on anticipated emotional response.

6.4.3.1.1 *Ownership and self-knowledge*

Multiple studies discussed the role of self-monitoring in fostering 'ownership' and self-knowledge amongst participants, increasing participants' ability to understand and control their own behaviour. In a Taiwanese study, peri-menopausal participants spoke of learning to 'listen' to their bodies through self-monitoring. One participant explained, "I feel that my body is "talking" to me, and I listen to its voice." (226) In two studies, participants spoke of how the act of writing itself increased awareness. (224, 225) A weight loss blogger explained, "It [blogging] makes me think about my choice by forcing me to put it into words." (224) In a second study, self-monitoring revealed new knowledge which in turn facilitated successful weight management, with one maintainer explaining:

"And when I started counting calories and I kept up the workout was when I actually started seeing real results. Because you never know how much you eat until you start counting calories." (201)

In a separate study, a maintainer explained how consciously monitoring her emotions helped her 'tighten up the reins' when it came to emotional eating:

"I write a lot, the feelings, and just try to understand what it's tied into... I know the emotions that I go through when I'm getting to the point where I get

real shaky, where I need to tighten up the reins or I'm really going to start having problems.”(204)

One maintainer referred to the scale as “my best friend” – she weighed herself every day and viewed the scale as a consistent and reliable presence which increased her self-knowledge.(223) These quotes from participants illustrate the way in which, by increasing awareness, self-monitoring led to an increase in self-knowledge which often engendered increased responsibility for one's own actions.

6.4.3.1.2 Feelings of fear and shame

Whereas this self-knowledge was predominantly viewed as a positive aspect of self-monitoring, linked to increased weight loss and maintenance success (219), in a study investigating the experiences of weight loss attempts in adults with obesity, one woman found anticipated ‘ownership’ to be a barrier to self-monitoring. She found recording her food intake to be “the hardest thing,” explaining, “I can't do that. Maybe it's the ultimate ownership of what I'm doing.”(211) Though this study did not expand on why ownership was difficult for this particular participant, one possible interpretation is that the feeling of responsibility engendered shame at a level that the participant did not wish to experience.

This interpretation is indirectly supported by other studies in which self-monitoring instigated feelings of shame, which often coincided with weight regain.(214, 223) Scale weight was viewed as personal, a reflection of self. A study exploring weight maintenance trajectories in British adults who had lost weight found regainers often stopped monitoring due to feelings of shame. A participant described weighing as “deeply personal... having to stand on the scales, and you know, feel ashamed.”(214) In

a separate study of weight loss bloggers, a participant illustrated a direct conflation of weight with self:

“I finally got on the scale today...are you ready for it? In true fat kid form, I gained 12.5 lbs in like a month...who does that? Elephants gestating twins don’t even do that. I’m completely ridiculous.”(224)

This shame may in some part explain participant accounts of fear – with fear of anticipated shame discouraging participants from self-weighing in particular. In one study, a regainer explained:

“Honestly it scared me. When jeans don’t fit, you’re scared to get on. I used to weigh myself. It doesn’t happen anymore.... It’s strange, because you want to see... because maybe it will tell you you’re almost at your full weight and you should stop. It scares me to get on.”(223)

In a second study, a regainer explained her reasons for discontinuing weight monitoring:

“I was too frightened to get on the scales. I knew that if I weighed myself and I had put on, then I’d just go off the rails, and eat and eat. So I’m better off not knowing.”(212)

6.4.3.1.3 Self-selection based on anticipated emotional response

At times, the emotions arising from the information revealed by self-monitoring led to self-selection of when and what to monitor based on anticipated emotional response – forming part of a vicious cycle or virtuous circle depending on the circumstances.

Where participants anticipated the recorded outcome would elicit a positive emotional response, they were more likely to monitor it, whereas if they anticipated a negative emotional response, they were less likely to monitor. A quote from one maintainer illustrated this in a positive light, “I feedback off seeing the weight coming down . . . I like to see it happening very quickly and therefore I actually want to keep weighing myself.”(214) However, this could also stop participants from self-monitoring in the maintenance phase, with anticipated weight gain discouraging participants from

continuing self-weighing. A participant explained, “I don’t like it [self-monitoring] if it doesn’t have any effect and I will almost back off the weigh scales then.”(214) In a separate study, a regainer explained:

“In maintenance you’re not actually achieving anything as such, well you are, but not in terms of the tangible result of losing weight. Initially I keep weighing myself and then you get to a point where it starts to creep up a bit and then you stop weighing yourself - because you don’t want to know how much it is.”(222)

In a final study, the authors draw attention to this phenomenon, noting that a common reason for stopping self-weighing was that participants knew they would receive negative feedback. They offer an example of a male regainer who was very cognisant of what his weight would be, but did not wish to see it on scale. He stated, “I avoid the scale at all costs. And even when I do get on it, I know within 3 pounds what it’s going to say. I avoid it because I don’t want to see it.”(223)

Multiple study authors highlighted that maintainers consistently and frequently engaged in self-monitoring as opposed to regainers whose monitoring tailed off once weight loss had been achieved.(204, 212, 214, 222) Often, this observation was used to imply that ceasing self-monitoring led to weight regain. However, this phenomenon of self-selection of monitoring based on anticipated outcome makes it very difficult to distinguish which happened first – were the regainers regaining because they stopped monitoring, or did they stop monitoring because they were regaining? These data make the latter seem more likely.

6.4.3.2 Attentive and reactive self-monitoring

Regardless of whether the feedback received was positive or negative, participant accounts illustrated an array of ways in which self-monitoring influenced their

behaviour. This included participants who used self-monitoring solely as a way to increase attention and adherence to their target behaviours (e.g. physical activity and food intake, whether through monitoring those behaviours themselves or monitoring the outcomes of those behaviours), and those who used self-monitoring as a way of collecting data to facilitate self-analysis (most typically including monitoring of both behavioural and outcome measures). In both paradigms, feedback from self-monitoring could serve as a prompt to perform specific actions.

6.4.3.2.1 Self-monitoring to increase adherence

In some participant accounts, self-monitoring served as a way in which to increase attention and hence adherence to desired behaviour change. This is in line with behaviour change theories which suggest that self-monitoring may work through bringing habitual behaviour into conscious awareness – by self-monitoring behaviours, individuals may be less likely to subconsciously stray from their behaviour change targets.(240, 242) For example, in a UK study of weight loss maintenance, a participant who had been tracking his food and exercise for the past five years explained:

“As long as you’re counting something, either calories or grams of fat, it’s helpful. I think it’s that little mind trickery of it, it makes it present in the mind, it makes it something that you just can’t kind of go ‘Well I’ll think about that tomorrow.’”(222)

In this particular case, the mechanism through which self-monitoring aided adherence to behaviour change was purely on the individual level, through monitoring the target behaviour. In other studies, adherence was enhanced by sharing of self-monitored data with others, which included outcome data such as weight. In contrast with the data in theme 1, where anticipated shame discouraged participants from self-monitoring, in these cases where self-monitored data were shared, anticipated shame could act as a

motivator to stick to behaviour change targets. A member of an online weight loss community explained, “knowing that I’m going to be documenting and sharing information about a behaviour makes me far more likely to carry it out.”(220) Though this study did not elaborate on the mechanisms in which this worked, data from theme 1 suggest it could be that the additional documentation and sharing increased motivation to adhere because of anticipated shame if the individual did not adhere to the targets they had set themselves. In a separate study of weight loss bloggers, a female participant who regularly logged behaviours and outcomes explained, “I needed a way outside of myself to stay accountable. By journaling online for everyone to see, I felt under more pressure to succeed, which helped me in the long run.”(224)

6.4.3.2.2 Self-monitoring to facilitate self-analysis

In contrast to using self-monitoring to enhance adherence, a separate group of participants used self-monitoring to facilitate self-analysis. Typically, self-monitoring was used to facilitate analysis through analysing recorded outcomes in light of recorded behaviours, e.g. contextualising scale weight based on food intake.(201, 219, 226) In a Taiwanese study of peri-menopausal women’s experience with weight loss, one participant explained, “I measure my weight every day... I often ask myself: did I eat too much recently? Otherwise, why did my weight increase?”(226) In their cohort of British weight loss maintainers, Hindle et al explain how self-monitoring allowed participants to quickly identify changes in target behaviours or outcomes and judge the impact of these.(219) In a study of American weight loss maintainers, one participant explained how the role of self-monitoring in his weight management changed over time. As the weight trajectory flattened, self-weighing became less of an aid to adherence and more of a route to analysis. He explained:

“I will gain a few pounds and so then I want to analyze it, “Why did you gain that weight? Is it because you just went off the program? Or is it because you weren’t watching your portions? Or you skipped some meals? What has caused this?” So I think the six or seven months after I’d actually lost the weight, it became more of a self-analysis. In the beginning it was routine. ‘This is the routine. This is what you set out for yourself and, lo and behold, you’re making successes.’ Then it became, in my mind, an analysis of why it was successful and how to keep it going.”(205)

This quote implies that self-analysis of self-monitored weight was positively reinforcing the participant’s desired weight management behaviours as well as discouraging the participant from continuing undesired behaviours. Linking desired behaviours with success helped the participant maintain motivation, and linking undesired behaviours with failure (i.e. weight regain) prompted the participant to discontinue those behaviours.

6.4.3.2.3 Self-monitoring to prompt action

Regardless of whether self-monitoring was primarily used for adherence or analysis, participants spoke of how self-monitoring outcomes could serve as a prompt for action. One maintainer explained, “I feel if I’m going to keep an eye on what my weight is then I need to know exactly what it’s at and then if it’s creeping up then I need to take corrective action.”(214) A further study comparing maintainers versus regainers in a population of African-American women found a sharp contrast between the two groups in this regard: maintainers identified tight-fitting clothing as the prompt to reinstate weight loss strategies, whereas regainers did not.(199) The authors do not elaborate on the reasons why regainers did not use this prompt; it could be that they did not recognise this as a prompt, or that they recognised the tighter fit but chose not to act on it. In a final case, analysis was an intermediate step that informed what the prompted action would be. A maintainer explained:

“If I put them [jeans] on and I feel this is not fitting the way it did yesterday, or the week before, that tells me right then that there’s something I’m not doing right and my weight is going back up. It’s not the jeans getting small so I have to look at what I’m eating.”(223)

This is a clear example of the component of Kanfer’s model of self-regulation in which negative feedback from self-monitoring an outcome leads to an evaluation of the way in which behaviour affects that outcome.

6.4.3.3 Trust and deception

Sitting alongside emotions, analysis and adherence were the interlinked concepts of trust, honesty, and deception. When it came to monitoring outcomes in particular, participants seemed to make deliberate choices about whether to use quantifiable measures (e.g. weight as measured on weighing scales) or other, more visual forms of measurement (e.g. looking in a mirror). These decisions seemed to revolve around trust in the measure, but there was variation amongst participants in terms of what was considered trustworthy. For example, a weight loss maintainer explained:

“I have to weigh myself at least every other day...cause if I don’t have measurements, I can feel that I’m maybe gaining a little weight but sometimes I can talk myself outta that, but the scale doesn’t...lie.”(206)

In contrast, other studies included participants who rejected scale weight measures. For example, a weight loss maintainer stated, “I see myself in the mirror most days. I’m more concerned with what I look like rather than the numbers on a scale.”(212)

In multiple studies, a particular issue with scale weight measures was their inability to disentangle fat and muscle mass from a simple measurement of total body mass. In a study of male discourses on weight loss, Bennett found that the notion of weight as measured by a weighing scale was rejected by some participants due to this; as a result, the use of body fat measures was popular as an addition to, or replacement for, scale

weight measure. The scale was labelled a “lying bitch” by one participant due to its inability to distinguish between body fat and muscle.(210) In a separate study, a female maintainer remained committed to self-weighing despite her acknowledgement that it was negatively impacting her efforts at strength training and was not reflecting fat mass:

“And then I would do strength training and I was really going. But then that wasn’t working, because then I was seeing my weight go up a little bit. It was probably muscle, but I could not acknowledge that. For me it was just the weight. Even though the doctor explained, “you’re taking on muscle weight.” I could not believe the numbers, how they’re still controlling me. It’s still the numbers.”(204)

In this case, the participant implies that though she distrusts the scale, she still feels compelled to monitor her weight and work towards her weight targets, possibly because of the pivotal role played by self-weighing in the initiation of her weight loss attempt.

Though discussions of trust mostly centred on outcome data derived from measuring instruments, trust in behavioural measures could also vary. In this case, the issue was not with the mode of measurement but, linking with theme 1, with a fear of anticipated shame that could lead to self-deception. In a study of the phenomenology of repeated diet failure, Green identified the theme of ‘multi me’, explaining the way in which the self was fractured into a watcher and the person doing the action; here, anticipated shame led some participants to self-deceive, whereas vigilance necessitated “being honest with oneself”.(217) A participant explained:

“Mmmm. No, I’d be, I’d feel brave to write it down, but ashamed at the same time...[]...the kidding thing is by not writing it down ... or I, what I’ve done is, I have started to write it down, in fact I’d probably completed a whole day, but I’ve conveniently left things out ... so it isn’t written on the paper, so I look—oh yeah! Oh 20 points that is, that’s ok! You know you’ve had a—I’m exaggerating, but you’ve had a cream cake, you know, and you’ve forgot to put it down—and I’ve conveniently forgot to do it—so it isn’t—you’re not being honest with yourself.”(217)

This contrasted with another study, in which successful maintainers discussed how monitoring kept them “honest”, but did not describe the mechanism through which this was achieved.(222) The interplay between deception and honesty ties in with earlier accounts of participants avoiding self-weighing in instances where they anticipated negative feedback (e.g. weight gain) – those accounts could be interpreted to imply that, though participants knew they had gained weight or were partaking in behaviours which may lead to weight gain, they avoided self-weighing as it would provide definitive evidence of this fact.

6.5 Discussion

6.5.1 Integrated model

Though coherent individually, as illustrated above and in Figure 18, the three analytical themes identified in this data are also interrelated. As explored in theme 2, one can conceptualise the role of self-monitoring in weight loss on a continuum, ranging from an aid to increase adherence to behaviour change targets (operating through increased awareness and accountability), to a tool purely to facilitate analysis and self-experimentation (more in line with Kanfer’s model of self-regulation (242)). An individual’s ability to analyse is directly related to their understanding of, and trust in, the parameter(s) they are measuring (theme 3); for some participants the quantitative measurements appear preferable, whereas others opt for more subjective measures.

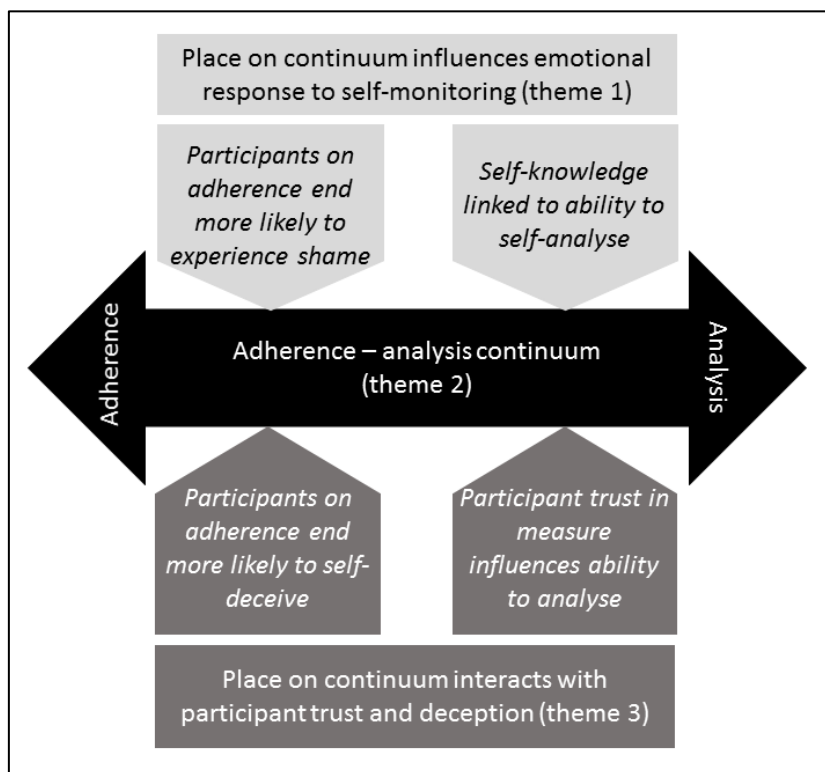
This continuum can also be used to explain differing emotional reactions to self-monitoring (theme 1), which may explain why some participants stop self-monitoring as weight regain commences, and others are able to use self-monitoring as an effective tool to curb weight regain. In the Foucauldian framework of a neo-liberal society, self-

knowledge and personal responsibility are at the core of the concept of a responsible citizen; by taking responsibility for one's own health and wellbeing, the individual diminishes their burden on society. In this context, monitoring conducted only in the 'adherence' end of the continuum means unfavourable results/readings can only be interpreted as a failure.(243, 244) In participant accounts, the emotional response to, for example, weight gain, when weight monitoring was done purely to enforce one's adherence to their plans and goals, was negative; the weight gain represented a failure of the individual to conform to the goals they set themselves. Under a Foucauldian model, failures of this type could take on a moral valence – representing a failure to adhere to the ethical requirements of modern society. Of course, there is another plausible reaction to this initial negative emotion – that it would drive people forward to greater effort to maintain their weight – but there are no accounts in these data which illustrate this mechanism other than those where self-monitoring is a shared enterprise with others (e.g. in studies of weight loss blogs, where accountability may be increased through outside forces).

In contrast, when self-monitoring was done to facilitate analysis and action, overtly negative reactions did not emerge. When self-monitoring was conducted to aid self-analysis, no participants spoke of ceasing self-monitoring in reaction to negative feedback, nor did any accounts of self-deception emerge. This illuminates how, in the context of self-analysis, negative feedback (e.g. weight gain) can play a different role than in adherence models – it can serve as data with which to facilitate an individual's quest for self-knowledge, rather than only as a reflection of the individual's personal failing. As self-knowledge is a core component of the ethical individual (in Foucault's paradigm (244)), and in light of societal structures that privilege knowledge viewed as

scientific (as per Lupton (243)), the weight reading, though undesirable, is not inherently linked with morality, and therefore is not inherently linked with shame, either – the morality of the subject is still preserved as long as they interpret and act on the data. Though anticipated shame is often a good thing – inhibiting people from doing a range of actions that are not desirable from a societal perspective – here, anticipated shame more commonly led to self-deception and/or abandonment of self-monitoring efforts.

Figure 18 Illustration of interlinkages between analytical themes



6.5.2 Summary of main findings

In summary, self-monitoring was a frequent focus in participant accounts of self-directed weight loss. Overall, the data from these accounts highlight the centrality of the personal interpretation of feedback - whether the feedback be from a weighing scale, an exercise machine, or a food diary - and implications of this interpretation on an

individual's sense of self. The participants in this review who used self-monitoring purely as a means to increase adherence to their weight management plans consistently interpreted negative feedback – e.g. calorie intake above target, weight gain – as a failure, often engendering feelings of fear and shame, which in some cases led to discontinuation of self-monitoring and/or self-deception. In contrast, in those who used feedback as data to facilitate self-analysis (in line with the stages laid out in Kanfer's model of self-regulation), negative feedback was interpreted as a prompt to action, with shame playing a less overtly prominent role, arguably due to the moral valence given to self-analysis and self-knowledge.(243, 244)

Notably, other than ownership, self-knowledge, and providing a drive to continue self-monitoring, there were no participant accounts of self-monitoring directly generating positive emotions. This may be because self-monitoring did not elicit these emotions in this group of individuals, or it may reflect the nature of the questions asked to participants. If I assume the former, this data then suggest that the emotional drive from self-monitoring in the 'adherence mode' is linked to the need to relieve the negative emotions of shame and fear that arise when the feedback from self-monitoring is negative (e.g. not hitting one's targets). This does not necessarily mean that fear of shame always has negative consequences – it may serve as a powerful motivator – but the accounts above illustrate the role it can play in discouraging ongoing self-monitoring.

6.5.3 Strengths and limitations

A major strength of this analysis is that, to the best of my knowledge, it is the first of its kind to systematically review the literature on self-monitoring as part of self-directed weight loss attempts, synthesising findings across a range of study designs and settings.

In addition, study selection was not limited to studies which focussed on self-monitoring (indeed, none had this as their explicit focus) – but rather to those which discussed any cognitive or behavioural strategies used in self-directed weight management attempts. This means that participant accounts of self-monitoring are arguably more comprehensive than those that would come from a self-selected population of people who volunteered to take part in a study specifically on self-monitoring. Similarly, reviewing data only from self-directed weight management attempts provides different perspectives on self-monitoring than those that emerge from evaluations of formal weight management interventions where instruction to monitor may or may not be a formal component of the programme. Finally, using a mix of inductive and deductive approaches allowed new themes to emerge from the data, whilst analysis was strengthened by drawing on relevant existing theory.

One limitation of the analysis is that my initial inductive coding may have been coloured by existing knowledge of the literature in the area. In addition, as with Chapter 5, the strengths of this review are also tempered by the scope and quality of the included studies. Quality assessment raised issues for many of the studies, and a number of the included studies were unpublished theses. The majority of studies were undertaken in well-educated white women in developed, Anglophone countries, an issue which also affects quantitative research in this area.⁽²³⁴⁾ In most cases it was unclear what questions were asked to participants; it is difficult to determine if the content of the studies accurately reflect the experiences of the participants, or if the studies' results have been tailored based on the interests of the researchers. This is somewhat countered by the fact that this review draws primarily on verbatim quotes from participants, but

choices will have still been made by study authors as to which quotes to include and which ones to omit.

6.5.4 In context of existing literature

Though self-monitoring of weight has been found to be associated with successful weight loss and weight loss maintenance, the mechanism behind this association remains unclear.(90, 245) As observed in systematic reviews, randomized trials of weight loss interventions have shown significantly greater weight loss at a year for treatments involving self-monitoring (including use of food diaries and self-weighing).(68, 69) However, it is difficult to isolate the impact of this self-monitoring from other intervention components – this is a particular challenge as the vast majority of these studies used self-monitoring, making between study comparisons (for example meta-regression) less meaningful for this variable. In addition, participants in these studies would have been weighed by other people (either as part of the intervention or to facilitate data collection for the trials), and accountability may improve the effectiveness of self-monitoring – a finding that was supported by the two studies of online weight loss communities included in this review.(235)

Studies specifically testing the addition of self-weighing instruction and scale provision have shown mixed results, and findings from this review may shed some light on why self-monitoring may facilitate weight management in some individuals and not in others.(235, 246, 247) For example, one possible reason for this variation is the way in which the individuals react, interpret and act on the data – some negative feedback is probably inevitable in any sustained weight loss attempt, and accounts from this review suggest that when such feedback is viewed as data to aid analysis, rather than as a moral judgement of personal failing, self-monitoring efforts are more likely to continue and be

successful. This use of self-monitored information is closely linked to the behaviour change technique known as self-experimentation, and is also reflected in self-regulation theory and Lupton's work on the Quantified Self movement.(94, 242, 243)

Existing literature on the role of self-monitoring in self-directed behaviour change attempts is sparse. Self-regulation and other behaviour change theories as they relate to self-monitoring and weight change are most commonly studied and described within the context of formal interventions(235, 248); the most relevant work on self-monitoring in a self-directed context emerges from studies of the Quantified Self movement.(243)

Though the Quantified Self movement only represents one segment of self-monitoring, recent analysis of the movement has enabled the themes identified in this review to be put in broader context, in relation to both the use of self-monitored data and the impact of societal and political discourses about morality on the experience of self-tracking.(243, 249) Foucault has argued that, in the modern neo-liberal state, improvement of self is viewed as an ethical project, a personal responsibility to be a 'good citizen.'(244) Lupton refers to this as the 'ethical project of selfhood' – people are compelled to develop self-knowledge, engage in self-care, and take responsibility for the outcomes of their lives.(243) These concepts are closely tied in to the discourses on self-analysis and shame that emerged from this review, but data from this review suggest that, at least in some people, this moral project of the self is destructive to achieving the very ends it appears to expect people to achieve. Findings suggest that discourses on self-monitoring are inherently related to the broader political framework in which self-monitoring is enacted, and that the interplay between the two warrants further consideration.

6.5.5 Future directions

Data from this review suggest a number of future directions for research. Firstly, and as discussed in Chapter 5, studies of self-monitoring in self-directed weight loss need to extend to a diverse range of populations; self-tracking technologies are predominantly used by white, middle-class, and well-educated people (243), and studies in this review broadly represent this demographic to the exclusion of others, meaning that the existing body of literature often fails to consider broader social and environmental factors that may influence self-monitoring. Secondly, data from this review suggest there is not a one-size-fits-all approach to the tools and modes used for self-monitoring for weight loss; future studies testing interventions which include self-monitoring could, where possible, consider offering participants choices of the monitoring tools they would like to use, in order to enhance participant trust in the data (e.g. weighing scales or other means of measuring body fat), or, alternatively, could actively seek to enhance participant trust in the measure before asking participants to commence use. Thirdly, it would be valuable to further explore the findings that have emerged from this analysis, particularly in light of the limitations with some of the data; probing individuals to understand why they react to self-monitoring the way they do and whether it is the ethical project of the self that drives this would be useful in future investigations.

In conclusion, further detailed analysis of the accounts of self-monitoring contained in the studies from Chapter 5 illustrate that self-monitoring can both reward and rebuke users and that both emotional forces can foster motivation to continue or adhere to weight management targets. However, multiple accounts emerged where shame and anticipated shame did not drive participants to continue positive behaviour change efforts, but rather led to abandonment of self-monitoring. Accounts from this review

suggest that framing self-monitoring as a tool to aid analysis may go some way to mitigate this phenomenon. As such, findings suggest that interventions could benefit from explicitly encouraging participants who self-monitor to view the process as a way to facilitate self-analysis, rather than purely as a means to engender adherence. This could be translated into the advice made available to people embarking on self-directed weight loss attempts, as discussed further in Chapter 7.

Chapter 7 Discussion

7.1 Summary

This chapter concludes the thesis, first summarising the individual chapters and then discussing the dissertation as a whole in terms of its overall strengths and limitations, contributions to the existing evidence base, and the implications for research, policy, and practice. The research contained in this dissertation is strengthened by the demonstrable need for more evidence on self-guided weight loss attempts and the strategies individuals use as part of these, and the robust mixed-methods approach undertaken. It is limited by uncertainty over the scope of the taxonomy of self-management strategies and whether it is comprehensive, issues with demographic representativeness, and the potential impact of an ‘observer effect’ on findings in some of the studies. Despite uncertainty over its scope, the creation of the taxonomy is a key contribution of this dissertation, as it represents a first attempt to fill a previous void in terms of tools with which to evaluate the cognitive and behavioural strategies used in weight loss attempts from the perspective of the individual. In addition, research contained in this dissertation has contributed new analyses relating to the effectiveness of self-help materials in improving self-directed weight loss success, experiences of self-directed weight loss, and associations between strategy use and weight loss outside of the context of a formal intervention. Findings point to a number of future directions for research as well as for policy and practice.

7.2 Overview of the thesis

As outlined in **Chapter 1**, the aim of this dissertation was to hone in on the cognitive and behavioural strategies used by adults with overweight or obesity attempting to lose

weight and maintain that weight loss, particularly in self-guided weight loss attempts, and to test the relationship between use of these strategies and weight loss success.

In order to explore and evaluate the cognitive and behavioural strategies used for weight loss, it was important to first define these strategies using a common language that could be applied in a range of different contexts. At the time of starting this research, no tools existed which enabled this to be done, and hence the first step in this research programme was to build the OxFAB taxonomy and questionnaire, as set out in **Chapter 2**. These tools provide a conceptual framework with which to identify the cognitive and behavioural strategies used by individuals during weight loss attempts.

In **Chapter 3**, the OxFAB taxonomy was used in a systematic review and meta-analyses that set out to determine the effectiveness of self-help interventions for weight loss, to identify their effective components, and to examine their applicability across the spectrum of socioeconomic status. Previous reviews in the area had focussed on specific delivery modes rather than exclusively on those interventions that required no human input for delivery, making this review the first of its kind, as far as I was aware. Pooled results showed that self-help materials led to greater weight loss than unsupported attempts to lose weight at six months, though applicability of these results to socioeconomically disadvantaged populations was difficult to determine, as were effects at a year or longer. Interactive and tailored elements appeared to improve intervention effectiveness. This review allowed me to test the use of the OxFAB taxonomy in categorising intervention content; the taxonomy proved useful and useable for this purpose. However, there were insufficient data in study reports with which to investigate the relationship between weight change and OxFAB taxonomy domains.

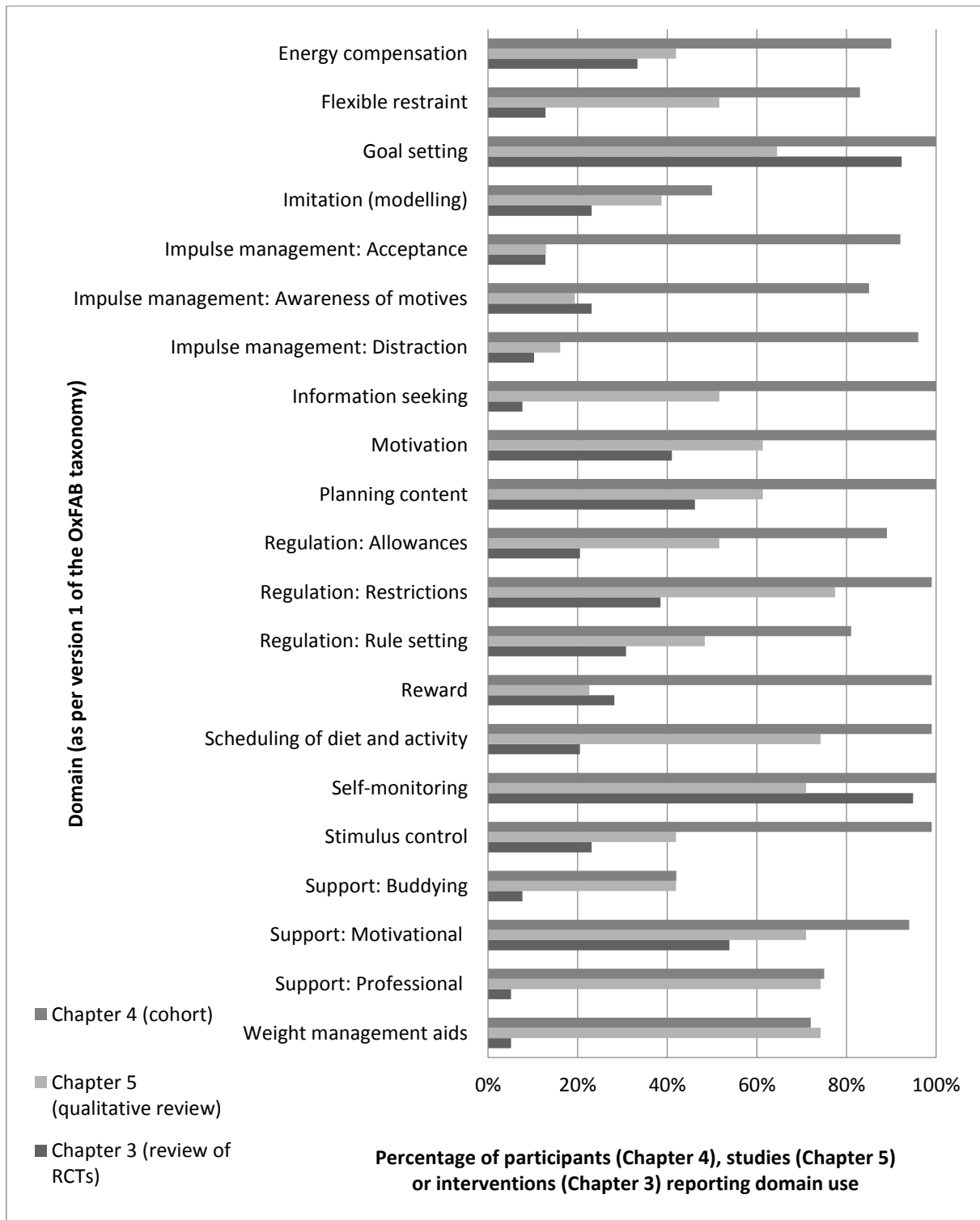
Chapter 4 presents results from a prospective, observational cohort study investigating the strategies used by UK adults with overweight or obesity attempting to lose weight through behaviour change. Strategy use was measured with the OxFAB questionnaire. Despite heterogeneity in the strategies employed for weight loss, coherent patterns of behaviours emerged for individual participants, some of which were associated with greater weight loss. In particular, greater weight loss was associated with use of strategies in the motivational support, self-monitoring and information seeking domains of the taxonomy and with two data-derived patterns of strategy use: dietary impulse control and weight loss planning and monitoring. Higher scores in an *a priori* model of essential behavioural strategies were also significantly associated with greater weight loss.

Whereas Chapters 3 and 4 relied on quantitative methods, **Chapters 5 and 6** explore the cognitive and behavioural strategies used in self-directed weight loss through the lens of participant experiences of these strategies. This was done through systematically reviewing and synthesising relevant information from qualitative studies. **Chapter 5** reports the methods for this review and characteristics of the included studies, mapping the strategies reported onto the OxFAB taxonomy and using narrative synthesis to explore attitudes and beliefs surrounding the choice and implementation of these strategies. Two new groups of strategies were added to the taxonomy based on findings from this chapter: reframing and self-experimentation. Participants' attitudes and beliefs surrounding groups of strategies were mixed. Generally, a wider range of strategies were discussed in relation to weight loss maintenance than in relation to acute weight loss attempts.

The breadth and depth of information captured as part of the review described in Chapter 5 was more than initially anticipated. This created an opportunity to use this review as a starting point from which domain-specific analyses could be conducted to enable richer and more detailed analysis to be undertaken than was possible in the overview presented in Chapter 5. The first of these domain-specific analyses is presented in **Chapter 6**, which explores the role of self-monitoring in self-directed weight loss. Data were analysed using thematic synthesis techniques and illustrate the phenomenon of self-monitoring experienced and enacted in a variety of ways, which differed between individuals and included interlinking analytical themes relating to self-perception and emotions, reactive self-monitoring, and trustworthiness of data. Findings from this synthesis suggest there is not a ‘one-size-fits all’ approach to self-monitoring in self-directed weight loss, but that using self-monitoring to facilitate analysis as opposed to purely using it to increase adherence may remove some of the barriers to its continued use.

Chapters 3, 4 and 5 all involved classification of strategies using domains from the OxFAB taxonomy, and in addition to findings from the individual chapters, some observations can be drawn by comparing coding across chapters, as seen in Figure 19. In almost all cases, the percentage of use individual domains was higher across participants in the cohort study than in the systematic reviews; this is not surprising given space limitations in the published articles, many of which did not have as their focus cognitive and behavioural strategies. However, even bearing this in mind some clear patterns emerged. Self-monitoring and goal setting appeared to be commonly employed across all chapters, which is broadly to be expected given the prominent role both play in weight loss literature. Weight management aids and seeking of professional

Figure 19 Domain coding across Chapters 3, 4 and 5



support appeared with relatively high frequency in the qualitative studies and in the cohort study, whereas they were rarely recommended by self-help interventions; this could be because the interventions sought not to recommend things that may not have been available to all participants (e.g. access to medical care and exercise equipment) or things without evidence of effectiveness, but data from participants suggest these tools are widely used. Impulse management strategies and stimulus control were frequent among cohort study participants, but appeared in much less frequency in the two systematic reviews, suggesting these areas may warrant further attention from researchers. Strikingly, all domains were used to some extent across all analyses, reflecting the relevance of the OxFAB taxonomy domains across these different contexts.

7.3 Strengths and limitations

Strengths and weaknesses of the individual studies presented in Chapters 2 through 6 are discussed in the relevant discussion sections of those chapters. However, there are some strengths and limitations that apply to this dissertation as a whole. These are discussed below.

7.3.1 Strengths

When this dissertation started, there was a clear and demonstrable need to map the area of self-directed weight loss in order to document current activities and pave the way for future evidence-based interventions (see Chapter 1). A key strength of this research, therefore, is the importance of the research area it explores, especially given the prevalence of obesity, the need for scalable interventions, the number of adults with overweight or obesity who are already embarking on self-directed weight loss attempts,

and the large gaps in knowledge around these attempts. As explained in Chapter 1, the majority of adults trying to lose weight are doing so without formal support, yet most research into weight loss focuses on relatively intensive interventions, rather than on self-directed weight loss attempts. This hampers the ability of researchers, clinicians and policy-makers to make evidence-based recommendations about the types of strategies individuals should be recommended to use when embarking on weight loss attempts. To this end, any well-conducted research exploring self-directed weight loss attempts is likely to be useful given the paucity of the existing evidence base. The OxFAB taxonomy has been explicitly designed to facilitate such research, and as such is an enduring legacy of this dissertation. To the best of my knowledge, no other research tool in this area has been created from the perspective of the user of the techniques, rather than the deliverer.

A further strength of this research is the way in which the research aims were addressed. Rather than focussing on one method or type of methodology, the research presented in this dissertation used a number of different methodological approaches, including both qualitative and quantitative, using gold-standard methods for evidence synthesis where relevant. In doing so, the analyses contained in this dissertation systematically draw on a range of available sources, which allowed the topic to be viewed from a number of different angles to form new insights about self-directed weight loss. These include behaviour change theories, behaviour change taxonomies, randomized controlled trials, commonly used weight loss interventions, a cohort of adults with overweight or obesity embarking on weight loss attempts, and qualitative studies of self-directed weight loss and weight loss maintenance.

7.3.2 Limitations

There are five principal limitations which must be taken into account when considering the research contained in this thesis in its entirety.

The first relates to the comprehensiveness of the OxFAB taxonomy and questionnaire, which are the foundation of this dissertation. These tools were crucial to enable the studies contained in Chapters 3, 4, 5 and 6 to be conducted and hence limitations with these tools potentially impact all of the studies. As discussed in detail in Chapter 2, the taxonomy used is only the first version, designed to generate discussion and to encourage consideration of the strategies from the perspective of the participant. There are therefore legitimate considerations of completeness. Though data saturation was reached in the initial stage of coding self-management resources, and though think aloud interviews did not generate strategies not covered by the questionnaire, there may be some relatively less common strategies that are not currently included. Indeed, two further domains were identified in subsequent analyses (Chapter 5). As the taxonomy continues to be used, especially by different research teams and in different contexts, it is anticipated that more new strategies may emerge. When and as they do, they will be incorporated into future iterations – this includes those domains identified in Chapter 5. Future iterations of the taxonomy are also likely to be informed by new research into cognitive and behavioural strategies for weight loss; for example, two papers have been published since the first version of the taxonomy which seek to further characterise impulse management processes as they relate to food intake and weight loss.(185, 250) These papers tell us more about the strategies in the OxFAB taxonomy but also point to possible areas where new strategies may be introduced, for example ‘commitment by punishment’, which involves pairing temptations with some form of punishment, such

as a financial penalty or loss of time.(250) The taxonomy could also further be developed through wider proactive consultation, either in the form of a workshop or a survey sent to experts in the field. However, even though the taxonomy as it stands may be missing strategies, this does not invalidate the results presented here – it simply means the picture the results are painting may not be complete. This is to some extent inevitable in a research area in its relative infancy.

The second overall limitation relates to the demographic representativeness of the populations included in this research. In particular, Chapters 3, 5 and 6 present results from systematic reviews in which the majority of the included studies were conducted in predominantly white and female participants of higher socio-economic status, mainly in developed countries. In addition, the study presented in Chapter 4 had an open recruitment strategy that did not target groups with specific demographic characteristics, and recruited a population similar to that of the studies in the systematic reviews. Future research in this area should target a more diverse range of people, especially given the paucity of data to narrow inequalities in obesity (Chapter 3) and evidence suggesting that self-help interventions may be most effective for the most socioeconomically advantaged participants (also see Chapter 3)(148), and given evidence from Chapter 4 that some elements of strategy use appear to be associated with demographic characteristics (e.g. gender and university degree associated with greater use of some strategy patterns).

The third limitation relates to a fundamental difficulty inherent in studying self-directed weight loss – the observer effect, also referred to as the Hawthorne effect in clinical trials. This has been described elsewhere and has been documented in a number of different contexts (251, 252), but in essence the challenge is that by observing a

phenomenon, you, as the observer, may be changing it. This is particularly the case for the cohort study presented in Chapter 4 – some might argue that participating in this study was a weight loss strategy in itself. Even without this element, it may be the case that being asked about particular strategies prompted participants to use strategies of which they may have otherwise been unaware. This is also a concern for those qualitative studies analysed in Chapters 5 and 6; generally the focus was on something other than self-management strategies, but it is still possible that participants were prompted to discuss the use of certain strategies or that certain strategies were given undue prominence in study reports.

The fourth limitation – to some extent inevitable in a dissertation of this type – is that further studies relevant to the systematic reviews presented in Chapters 3, 5 and 6 may have been published after the last search date for those reviews. This is always the case for systematic reviews and a pragmatic decision must be taken as to when to stop searching and start analysis and write up. For example, in the case of the qualitative systematic review (Chapters 5 and 6), I'm aware of one study which was published since the last search and would have been eligible for inclusion.⁽¹⁸⁹⁾ I have since read this article, however, and it does not contain data that are inconsistent with my analyses. In the case of Chapter 3, the full article describing results from one of the included studies was very recently published (in the month preceding submission of this dissertation) – though the author had been contacted at the time I was conducting the review, she was unable to share results then.⁽¹⁴⁹⁾ I am also aware of at least one other study that has been published since the search date for this review which may have been eligible for inclusion.⁽²⁵³⁾ Reassuringly, a recently published systematic review

evaluating self-directed interventions for weight loss had findings consistent with mine.(254)

The final limitation relates to the scope of this research. When viewed in light of the many drivers contributing to obesity and explored in Chapter 1, the scope of this review is narrow, focussing only on individual-level efforts to change behaviour rather than on environmental changes to support weight control. However, this is only a limitation if these results are taken out of context to imply that this is the only area worthy of focus. Of course it is not – obesity a population-level problem and needs population-level solutions, with an emphasis on prevention. However, in the meantime the prevalence of obesity continues to climb, and three-quarters of adults who are overweight or obese are trying to lose weight; the research contained in this thesis aims to ultimately to inform the provision of better advice for this population, increasing the success of these attempts. It is hoped that such work will be done in conjunction with environmental level changes, working symbiotically to enhance success at both levels.

7.4 Contributions of the research to the existing evidence base

The McKinsey report on interventions to combat obesity (discussed in Chapter 1) likened itself to a 16th century map used by navigators – some islands were missing, some continents misshapen, but they were still helpful to sailors of that era, and were a starting point for the development of the maps we use today.(34) If we continue that metaphor forward, this thesis perhaps helps define the shape of a country, or even a continent, on such a map. The limitations noted above may render it closer to Captain-Cook level mapping than NASA, but it helps define previously uncharted territory,

illuminating the route to future discoveries, and it is herein that its main contributions to the evidence base lie.

This research was conducted against a backdrop of research which seemed centred on certain points to the exclusion of others; this thesis provides one route for moving forwards. The first of these sticking points was the idea that changing diet composition was the solution to weight loss. Studies of weight loss attempts, whether self-directed or involving more intensive interventions, tended to focus on food types and specific diet programmes.(53, 56, 70) Indeed, if this research into self-management had been conducted 10 years ago, the questions we would be asking participants might have centred on what diets they were following – whether it be high protein, low fat, or otherwise. However, more recent studies have suggested that adherence to a low energy diet may have a stronger influence on weight loss than the nutrient composition of the diet itself (see Chapter 1).(96, 97)

Second is the concept that to lose weight one *simply has to eat less* – and it matters little how one goes about achieving this. Increasingly, and as discussed in Chapter 1, it is recognised that it is not that simple after all – systematic reviews show that weight loss studies in which the same energy deficits are prescribed can result in very different weight loss trajectories, both within and between studies.(68, 255) As a result, there has been increasing acknowledgement that the evaluation of underpinning behaviours (e.g. behaviours which influence consumption) may more clearly differentiate between successful and unsuccessful weight loss attempts than differences in what diets are recommended (e.g. prescriptions). Behaviour change technique taxonomies such as that developed by Michie et al have had a key role in this shift.(94)

Such taxonomies, however, bring us to the third and final sticking point - a focus on intensive professional-led interventions, to the exclusion of self-directed efforts at behaviour change. This is not surprising – randomized controlled trials show that on average intensive behavioural interventions are more likely to lead to significant weight loss than self-directed attempts.(68) In addition, self-help interventions may be harder to study: effects are often small, meaning trial size has to be very large to detect a statistically significant difference between arms; the intervention is relatively low intensity and requires a low level of commitment by its very nature, which may adversely impact follow-up rates; and enrolment in the trial itself often provides a type of behavioural support above and beyond the self-help intervention (e.g. weighing by study staff), which may subvert the very aim of the trial. Furthermore, it is arguably easier to change the behaviour of an interventionist, where clear guidelines and reporting structures are in place, than to attempt to directly alter the behaviour of individuals without individual interventionist input. Studies of intensive, practitioner-led interventions are therefore more able to attract funding, either from public sources or in the form of sponsorship from companies developing and providing such interventions. However, many of these interventions are resource-intensive, making them difficult to deliver at a population scale and leading many people to choose not to use them even when provided free at the point of use. Given obesity is a population level problem, and most people trying to lose weight are doing so without such interventions, self-directed weight loss clearly warrants further research.

The research contained in this thesis therefore contributes to the evidence base by moving beyond these common sticking points. The review presented in Chapter 3 was to the best of my knowledge the first to systematically evaluate weight loss

interventions which did not require human input for delivery; it showed that they could deliver meaningful weight loss, and hence that such interventions designed to enhance the success of self-directed weight loss warranted further investigation. The review presented in Chapters 5 and 6 was the first, again to the best of my knowledge, to systematically review the qualitative evidence on self-directed weight loss, providing a valuable framework and insights with which to inform materials designed to enhance the success of self-directed weight loss attempts. The cohort study presented in Chapter 4 was one of the first to examine associations between cognitive and behavioural strategies for weight loss and weight loss success outside of the context of a formal intervention, and to my knowledge was the first to have done so using a questionnaire specifically relating to these strategies, which had been tested for reliability and face validity. Findings from this chapter point to clear areas for further investigation and patterns of strategy use which had not formerly been identified. Arguably, however, the most valuable contribution of this research is the creation of the OxFAB taxonomy itself, used in all studies in this dissertation.

Taxonomies are crucial for enabling the use of a common language and developing a common understanding of behavioural techniques, but before the OxFAB taxonomy no such taxonomy existed for evaluating behaviours at the individual, rather than at the interventionist, level.⁽⁹⁴⁾ Given the previous lack of such a taxonomy, this was a particularly intensive, and particularly rewarding, component of this dissertation. There is no established method for taxonomy development, so I drew on the approach used by Michie et al, adapting it for use with individual-level behaviours.⁽⁹⁴⁾ This included a qualitative analysis of existing resources, a review and mapping exercise of existing behaviour change taxonomies and theories, and input from colleagues with expertise in

relevant areas. Given the individual-level focus, I felt it was important to also simultaneously produce a questionnaire for use by individuals – a crucial component of establishing what is being used by whom and to what effect. This involved a careful process of translating technical wording into lay language, reinforced through validity and reliability testing. Though future work is needed on both tools (see 7.6.1 Research), they represent a step change in the way we think about categorising the strategies used by individuals embarking on weight loss attempts.

As demonstrated in this dissertation, the OxFAB taxonomy and questionnaire can now be used in a variety of ways: to encourage a systematic approach to the description of the cognitive and behavioural strategies advocated as part of interventions for weight management (Chapter 3), such that the same strategy is described in the same terms, facilitating understanding and synthesis of research findings; to characterise the content of weight management attempts described in the current academic literature (Chapters 3, 5 and 6); and to help identify the active ingredients of weight management attempts at the level of individual implementation (Chapter 4). Through these routes the OxFAB taxonomy and questionnaire aim to stimulate the development of new interventions designed to prompt the adoption of the most effective strategies. As touched on briefly above, it is hoped that the OxFAB taxonomy will be an enduring legacy of this dissertation. Michie et al.'s taxonomy has transformed the way people think about and define behaviour change interventions – the most recent version was published in 2013 and has already been used in over 100 research articles to provide further clarity on intervention content. My hope is that the OxFAB taxonomy will build on this transformation by providing a new angle with which to view behaviour change

techniques – namely of the individual enacting the change, rather than focussing exclusively on the actions of the interventionist.

7.5 Dissemination of research findings

Ultimately, the studies conducted in this dissertation were designed to be both useful and impactful, to provide a unique contribution to this research area and improve the scoping of directions for new research, as well as to inform policy and practice in terms of the advice given to individuals. To date, results have been disseminated via the following routes:

- The taxonomy and questionnaire (Chapter 2) have been published in a peer-reviewed journal (99), presented at a conference, and promisingly have already been used by other researchers in the field to progress understanding of weight control attempts worldwide.(51)
- The review of self-help interventions (Chapter 3) has also been published in a peer-reviewed journal (69) and presented at conferences. At the time of submission, it had already been cited 12 times, and was also presented in a blog post on the journal website.(256)
- Results from the OxFAB cohort study (Chapter 4) have been presented at an academic conference. At the time of submission, an article describing these results was under review at *BMC Public Health*.
- An article describing results from the qualitative overview review (Chapter 5) has been accepted and was in press at *Obesity Reviews* at the time of submission.
- At the time of submission, an article describing results from Chapter 6 was under review at *Social Science & Medicine*.

In undertaking this research, it was my aim that its findings would not simply sit on a shelf, and I intend to continue to disseminate findings to a range of audiences and move this research forwards. Further implications and possible directions are described below.

7.6 Implications

7.6.1 Research

The studies presented in this dissertation point to a number of future research directions, relating in particular to further refining and use of the OxFAB taxonomy and questionnaire, new observational and qualitative studies, and intervention development and testing. Each are discussed in more detail below.

As discussed earlier, the OxFAB taxonomy presented in Chapter 2 and since published is considered the first version, with an explicit acknowledgement that it may evolve over time.⁽⁹⁹⁾ As discussed in Chapter 2, a crucial next step with the taxonomy is establishing its reliability when coding intervention content. In addition, whereas for the taxonomy the anticipated evolution involves expansion as more domains and strategies are added, for the questionnaire the intended trajectory is the opposite. As it stands currently the questionnaire contains 117 questions (one per strategy); this makes it burdensome for participants and limits its use. The next step for questionnaire development, therefore, is to cut down the number of questions, and efforts are in place to secure funding to do so. The hope is that the evolution of both tools will coincide with, and be informed by, their ongoing use in other contexts. The OxFAB questionnaire is currently being used in a randomized trial of a low energy liquid diet in primary care to inform analysis of the strategies used by intervention and control participants (ISRCTN75092026), and a number of funding applications are currently

being reviewed for projects that would incorporate its use, including the Western Australian Pregnancy Cohort (Raine) Study (257), and a repeated cross-sectional survey of English adults modelled off of the Smoking Toolkit Study.(258) As mentioned above, the taxonomy itself has already been used in a very recently published review of the prevalence of personal weight control attempts by adults conducted by a team independent from ours.(51) As with Michie et al.'s taxonomy, it would also be hoped that future studies of interventions targeting individual behaviour change for weight loss would use the OxFAB taxonomy to characterise intervention content in their study reports.

As well as use of the OxFAB questionnaire in other studies, there is also potential for the extension of the study presented in Chapter 4. The website and mobile phone applications remain available for use and, once the questionnaire is refined and were adequate funding available, they could be used to facilitate a study in a representative population, potentially with longer follow-up. Newer technologies, such as devices which naturally accrue data (e.g. bluetooth scales, fitbits) could be used to enhance data collection. The data collected as part of Chapter 4 could also be used for future analyses, which could be strengthened by a more representative sample with higher retention. These include evaluations of which patterns of strategy use work best for which people and in what circumstances, for example investigating the way in which strategy use changes over time, the stability of strategy use, and how these changes are related to weight change, and exploring whether associations between strategies and weight change appear to vary based on individual characteristics.

A further potential extension of research contained in this dissertation is to conduct additional domain-specific analyses arising from the qualitative review set out in

Chapter 5 and following a similar approach to the domain specific analysis contained in Chapter 6. Searches for this review could be easily updated and rescreened were a further analysis planned, with new data extraction forms entered into the same NVivo database and coded accordingly in order to keep the database up to date on a rolling basis. A quick search update followed by a domain specific paper may represent a good project for a junior researcher or student, and the database could be queried on an ongoing basis for specific terms to aid future intervention development.

Ultimately, it is hoped that such investigations would lead to the development of a novel self-help intervention for weight loss, centred on those strategies found to be associated with success (with results from Chapter 4 as a starting point), with interactive and tailored features (as suggested by the findings in Chapter 3) and informed by patient experiences, including positioning self-monitoring as a tool to aid analysis (with results from Chapters 5 and 6 as a starting point). Further qualitative work would need to be undertaken to develop understanding of how people engage with self-help resources and barriers and facilitators to starting and maintaining use of suggested strategies. The hope would be that, informed by this further development work, such an intervention could then be tested in a randomized controlled trial. Using lessons learnt from reviewing the studies in Chapter 3, the ideal future randomized controlled trial of a new self-help intervention for weight loss would contain more representative samples, especially in terms of socioeconomic status, follow up participants to at least 12 months, provide full details of the intervention (preferably by making the intervention version tested publicly available), and would not involve a wait list control, which risks biasing the results. The impact of the intervention would also be evaluated in light of existing health

inequalities, as such an intervention could conceivably serve to exacerbate rather than diminish such inequalities.

7.6.2 Policy and practice

Whereas future steps for research seem relatively clear, this is less so for policy and practice. A crucial tension in public health is at what point research warrants being put into practice. My research training has been conducted in an environment that reveres the high quality systematic review of randomized controlled trials, and continuously highlights limitations in existing evidence. However, if we were waiting for high quality randomized controlled trials to inform which strategies to recommend to individuals embarking on self-directed weight loss attempts, we might be waiting a long time, in the meantime missing out on valuable opportunities to help the people trying to lose weight now. Even if funding were secured for the above trial, it would take years for results to become available, and even longer for them to be implemented into practice. So if we aren't aiming for perfect, what constitutes good enough?

The 2014 McKinsey report discussed in Chapter 1 noted that, in many intervention areas relating to obesity “data from high-quality, randomized control trials are not possible to gather” and advised that, “rather than waiting for such data, the relevant sectors of society should be pragmatic with a bias toward action, especially where the risks of intervening are low, using trial and error to flesh out their understanding of potential solutions.” The report went on to warn that, though an ongoing investment in research to tackle the obesity epidemic is imperative, this should not serve as a barrier for action in the present moment.⁽³⁴⁾ Bearing this in mind, and given the relatively low risk presented by an evidence-informed intervention intended to help people embarking on self-directed weight loss attempts, I find myself inclined to feel less conservative

than usual when considering the potential impact of the research contained in this dissertation on practice. I fully acknowledge that when it comes to individual level cognitive and behavioural strategies for weight loss the evidence is far from perfect, but evidence in this field is rarely perfect – the question should really be when evidence can be considered ‘good enough.’ Given that we know many people are using weight loss strategies with no evidence base, it seems fair to replace these with better, if not ‘best’, strategies.(51, 88)

So what would this type of intervention look like? And how might it be implemented? We know from Chapter 3 that self-help interventions can lead to meaningful weight loss; as health risk is linearly related to excess body mass index, even modest reductions in weight in the range of those observed in Chapter 3 can have long-term health benefits for people who are overweight or obese.(32) Given the potential scalability and relatively low cost of this type of intervention, self-help programmes (i.e. those that don’t require human input to deliver) seem a reasonable place to start implementing some of the findings from this research. We know from Chapter 3 that interventions which involved some level of tailoring and interactivity appeared more successful; the most straightforward way to achieve this without human input at delivery would be via an automated, web or mobile phone based platform freely available and targeted at adults with overweight or obesity attempting to lose weight through behaviour change.

Such a platform could be new, perhaps providing advice based on the strategies included in the *a priori* model presented in Chapter 4, or could simply be an augmentation of existing resources, which would benefit from already having a core set of users in place. For example, the NHS has a website offering “12 tips to help you lose weight on the 12-week plan.”(259) These 12 tips are listed Table 21 – and some could

use updating. The first tip is to eat breakfast; a 2013 article in the *NEJM* identified this mantra regarding breakfast as a presumption – a widely accepted belief which has neither been proved nor disproved.(260) Trials published since have actually found evidence refuting this claim – findings suggest that if you randomize people to skip breakfast or not, those who skip breakfast will consume fewer calories over the course of the day and lose more weight.(261-264) The third tip is to eat more fruit and vegetables – this has also been identified as a presumption – *NEJM* authors write “when no other behavioural changes accompany increased consumption of fruits and vegetables, weight gain may occur or there may be no change in weight.”(260) A trial testing this found no differences in weight loss between groups that differed solely on recommendations for greater vegetable intake though a systematic review has shown a small reduction in body weight or reduced weight gain (0.68 kg, 95% CI 0.15 to 1.20) in favour of groups told to increase fruit and vegetable intake.(265) However, statistical heterogeneity was substantial in this meta-analysis and the authors note that longer studies are needed.(266) In addition, tip number 4 is ‘get more active’; though physical activity is of course healthy overall and leads to improved weight loss maintenance, it doesn’t appear to increase success in the short-term weight loss phase, which these tips are targeting.(179, 260) Cancer Research UK and NICE also have recommended strategies for self-directed weight management, though these are not written to solely inform weight loss and therefore are not directly comparable to findings from this dissertation.(267, 268)

Table 21 12 top tips from NHS weight loss guide

(1) Don't skip breakfast	(7) Read food labels
(2) Eat regular meals	(8) Use smaller plate
(3) Eat plenty of fruit and veg	(9) Don't ban foods
(4) Get more active	(10) Don't stock junk food
(5) Drink plenty of water	(11) Cut down on alcohol

(6) Eat high-fibre foods	(12) Plan your meals
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In summary, there is an audience for such lists in the UK, with some clear scope for improvement. At the time of submission, we were in talks with Public Health England about updating the content of the 12 top tips, listed above. On the back of this, I have taken the opportunity to create a new list based solely on the research contained in this dissertation, which is presented in Table 22. This list is primarily based on data from Chapter 4 (there is a tip for each strategy from the model of ‘essential’ weight management strategies) plus a tip relating to information seeking, which was not in the ‘essential’ strategies list but was significantly associated with weight loss in domain analyses. The list has also been informed by data from the qualitative review (particularly around framing self-weighing) and the quantitative review (many of the tips offer a choice of strategies, so individuals can tailor their plans to their needs and wants). Were the relevant website functionality available, such a list could easily become tailored and interactive through providing participants the opportunity to choose from a selection of approaches where multiple strategies fall under a single ‘tip’ (i.e. tips 2, 3, 6, and 10 below).

Whether through a new resource or through changes to existing resources, it would be crucial to ensure the materials reached their target audience. If data were used to augment an existing resource, this would be more straightforward, but even with NHS resources further work could be done. In particular, at the moment these resources would only help people already motivated to seek out this information, and who have the technological knowhow to find the information online. Ways to reach a broader audience as well could include advertising, whether through social media, Google Ad

Words, television or print campaigns, or a weight loss day or month similar to No Smoking Day or Stoptober here in the UK, which research shows are effective at prompting quit attempts.(269, 270) There is some reticence to encouraging people to lose weight on a population scale due to concerns about these campaigns causing adverse effects – for example promotion of eating disorders or weight stigma – and these would have to be examined for evidence on whether they occur. Were a campaign designed to be sensitive to these issues, it could offer the potential for significant health benefits in adults with overweight or obesity, as demonstrated by similar examples in smoking cessation.

Table 22 Strategies for successful dieting

1	Look up information on how to lose weight from sources you can trust – for example, government resources or sites recommended by your doctor or nurse
2	Set yourself food goals for how much you'll eat each day or each week – this could be in terms of calories, portion sizes, or nutritional content
3	Set yourself weight loss targets – have a goal weight in mind that you are working towards, or a certain amount of weight that you want to lose each week. You might want to write this down somewhere.
4	Plan your meals in advance to help you make healthy choices
5	Keep food that doesn't fit with your diet out of the house – it's a lot easier to stick to your food goals when you aren't being constantly tempted, so keep foods that don't fit with your diet out of your home if you can
6	Have a strategy for dealing with food cravings – you can't always avoid being around unhealthy foods, so it's a good idea to anticipate cravings and have a way to deal with them when they arise. Need some ideas? This could include chewing gum, waiting a certain amount of time to see if the craving passes, distracting yourself by focussing on something else, or being mindful of the craving – acknowledging it, but not acting on it.
7	Swap one type of food or drink for another if you know it's healthier for your diet – for example, choose lower fat or lower sugar versions of the food or drinks you'd usually have
8	Keep track of what you eat – you can help yourself meet your food goals by measuring the calories, portion sizes or nutritional content of your food. Don't forget to keep track of your drinks, too.
9	Weigh yourself regularly – this will help you measure your progress towards your target, but it will also help you learn about yourself. If you've gained weight, or not lost as much as you wanted, don't be discouraged – use this as an opportunity to learn more about how food and activity affects your weight. Knowing more about yourself can help you make healthier choices in the future.
10	Find ways to stay motivated – it's not always easy to do the things listed above, and it's important to find ways to keep going when you are flagging. This could involve

	other people – for example, trying to lose weight at the same time as someone else or telling other people about your weight loss plans. You could also reward yourself when you meet your targets (with something other than food), and keep a note to remind yourself of the reasons you want to lose weight.
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People not actively seeking this information could also be targeted through healthcare professionals, which could ultimately be encouraged by clinical guidelines. Patients could be referred to relevant materials (e.g. the list above), whether online or print based (I would suggest both be available to reach the broadest range of people); this could include patients actively seeking help with their weight but could also be used in opportunistic conversations about weight. We know from a recent trial that even bringing up weight as an issue can help with achieving weight loss, and it seems unlikely that having an evidence-informed resource to point people to on the back of such a cue would be harmful.(271) Though this could include referral to a behavioural weight management programme, we know many patients do not take up such offers – an evidence-informed self-help resource would add a further option to a practitioner’s toolkit. If we follow the thinking laid out in the Foresight and McKinsey reports (see Chapter 1), such an intervention may warrant translation into practice even on the back of a very limited evidence base.(8, 34)

7.7 Conclusions

In conclusion, the research contained in this dissertation maps out a previously uncharted area – namely the cognitive and behavioural strategies used by adults with overweight or obesity embarking on weight loss attempts, particularly those self-directed weight loss attempts which are conducted without support from formal interventions or healthcare providers. As such, it provides a useful set of tools for further research and intervention development. It also points to areas where we could

intervene now, demonstrating that self-help interventions can lead to significant weight loss, and providing evidence to guide the content of such interventions.

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Appendices

Appendix 1. MEDLINE search strategy for quantitative review (Chapter 3)

Appendix 2. OxFAB Study: data analysis plan (Chapter 4)

Appendix 3. MoSCoW list for browser-based application for recording weight and use of behavioural weight management strategies (Chapter 4)

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Appendix 7. MEDLINE search strategy for qualitative review (Chapters 5 and 6)

Appendix 1. MEDLINE search strategy for quantitative review (Chapter 3)

Run in MEDLINE (Ovid) 11 Nov 2013

1	Obesity/ or Obesity, Morbid/ or Obesity, Abdominal/
2	Overweight/
3	(overweight or over weight or overeat* or over eat* or overfeed* or over feed*).ti,ab.
4	(weight adj1 gain*).ti,ab.
5	obes*.ti,ab.
6	(weight adj1 los*).ti,ab.
7	(weight adj1 reduc*).ti,ab.
8	exp weight loss/
9	Obesity/dh, pc, th
10	Obesity, Morbid/pc, dh, th
11	Diet Therapy/
12	Diet, Fat-Restricted/
13	Diet, Reducing/
14	Dietetics/ed, mt
15	(diet or diets or dieting).ti,ab.
16	(low calorie or hypocaloric or calorie control*).ti,ab.
17	(health* adj1 eating).ti,ab.
18	(diet* adj2 (modific* or therapy or intervention* or strateg* or program* or management or scheme*)).ti,ab.
19	(nutrition adj2 (modific* or therapy or intervention* or strateg* or program* or management or scheme*)).ti,ab.
20	exp exercise/
21	(exercise and (therapy or therapies or activity or activities or program* or scheme*)).ti,ab.
22	(walk* or step* or jog* or run* or bicycl* or cycle* or cycling).ti,ab.
23	(aerobic* or physical therap* or physical activit* or active travel* or active transport* or active commut*).ti,ab.
24	(fitness adj (class or regime* or program* or group* or session* or scheme*)).ti,ab.
25	(reduc* adj2 sedentary behavio?r).ti,ab.
26	behavio?ral intervention*.ti,ab.
27	(change* adj2 lifestyle*).ti,ab.
28	(changing adj2 lifestyle*).ti,ab.
29	(lifestyle adj2 modif*).ti,ab.
30	life style/

31	behavior therapy/
32	health behavior/
33	or/1-10
34	or/11-19
35	or/20-25
36	or/26-32
37	33 and 34
38	33 and 35
39	33 and 36
40	or/37-39
41	controlled clinical trial.pt.
42	randomized controlled trial.pt.
43	(randomised or randomized).ab.
44	clinical trials as topic.sh.
45	randomly.ab.
46	trial.ti.
47	Meta-Analysis/
48	meta analy*.ti,ab.
49	(systematic* adj (review* or methodolog* or research* or search*)).ti,ab.
50	((hand or manual or computer or electronic or database) and search*).ti,ab.
51	(hand adj search*).ti,ab.
52	(medline or embase or Cochrane or cinahl or psychlit or psychinfo or scisearch or pubmed).ab.
53	Health technology assessment*.ab,in.
54	(pooled adj analys*).ti,ab.
55	(electronic* adj search*).ti,ab.
56	(synthes* adj5 (literature* or research* or studies or data)).ti,ab.
57	or/41-56
58	(internet or www* or web or computerized or web-based or net or online or podcast* or video*).ti,ab.
59	internet/
60	social media/
61	electronic mail/
62	(listserv* or "list serv*" or "list-serv*" or "mailing list*" or e-mail* or email*).ti,ab.
63	therapy, computer-assisted/
64	webcasts as topic/
65	podcasts as topic/
66	or/58-65

67	("mobile phone" or "mobile phones" or "cell phone" or "cell phones" or "cellular phones" or "cellular phone" or txt or pxt or sms or mms or app or iphone* or "android phone").ti,ab.
68	exp cellular phone/
69	67 or 68
70	("self help" or "self-help" or manual* or "information aid*" or leaflet* or booklet* or pamphlet* or workbook* or "self manag*" or "self-manag*" or "self-care" or "self care" or "self change" or self-change or "self directed" or self-directed or bibliotherapy).ti,ab.
71	self care/
72	manuals as topic/
73	patient education as topic/
74	health education/
75	consumer health information/
76	or/70-75
77	66 or 69 or 76
78	40 and 57 and 77
79	exp animals/ not humans.sh.
80	78 not 79
81	limit 80 to ("all infant (birth to 23 months)" or "newborn infant (birth to 1 month)" or "infant (1 to 23 months)" or "preschool child (2 to 5 years)" or "child (6 to 12 years)")
82	80 not 81
83	(editorial or comment or letter).pt.
84	82 ot 83

Appendix 2. OxFAB Study: data analysis plan (Chapter 4)

Study design

- Prospective cohort study
- Participants will be asked to report on the cognitive and behavioural strategies they are using to manage their weight (questions from the OxFAB questionnaire, developed through the OxFAB taxonomy) and to report on their weight at least once every three months.
- At baseline, participants will be asked to answer the full questionnaire. They will then be asked to log in episodically and indicate which strategies they are using.

Research questions

- What cognitive and behavioural strategies are overweight and obese adults using to try to lose weight?
- What are the associations, if any, between use of these strategies and weight change?

Participants and recruitment

- Participants will be recruited from the general public if they log on to the study website. The availability of the site will be advertised on a BBC website associated with a TV programme on weight loss airing across Britain in January 2015
- To be included in the analysis, participants must be overweight or obese adults (BMI greater than or equal to 25), resident in the UK, and trying to manage their weight through changes to their diet, physical activity, or both.
- *A secondary aim is to establish the feasibility of recruiting and retaining participants in this non-intensive study with few retention incentives, so as to determine future research plans.*

Variables being collected

- Self-reported weight (repeated measure)
- Use of strategies (most of the time, sometimes, never/hardly ever, plus not relevant and unclear, which for the purpose of analysis will count as never) (repeated measure) (Note: once we have data, to determine if this analysis will be binary or categorical – e.g. if most of the time and sometimes will be considered the same value, or different values – discussed and agreed this approach with Constantinos 12.2)
- Participant characteristics (baseline only)

Data format

(as discussed and agreed with Constantinos, Carmelo, Dario and Carmen, 12.2.15)

- Data analysis will be conducted in Stata
- Carmelo will format data as csv files
- There will be three sheets of data:
 - Self-management strategies and weight, clustered by date and participant ID (each row will represent a participant ID and date, and self-management strategies and weight will be reported in columns)
 - Answers to screening questions (with questions as columns and participant IDs as rows; where multiple values entered on one day, use latest value entered) – this will actually be in the form of two sheets, one with baseline data and one recording any subsequent changes to these fields
 - Demographic and all other information collected via ‘settings’ (with characteristics as columns and participant IDs as rows; where multiple values entered on one day, use latest value entered) – this will actually be in the form of two sheets, one with baseline data and one recording any subsequent changes to these fields

Analyses

Descriptive: participants

Demographic data collected at baseline (all participants):

- Height
- Weight (will be used alongside weight to calculate BMI)
- Highest level of education
- Postcode (will be used to establish area deprivation index (IMD))
- Ethnicity
- Gender
- Age
- Trying to lose weight through diet, activity, or both

Descriptive: strategies

- Data from all participants who have completed all relevant questions at least once
- Based on data provided at baseline (baseline defined as period over which participant answers all relevant questions exactly once)
- Frequency of use of each individual strategy
- Number of strategies used per participant

- Principal component analysis to determine how strategies group together (define clusters of strategies) (note: validity will be tested using split half method, or similar)
- Domain led analysis (how many domains used, 'domain use' defined as use of at least one strategy in that domain) – frequency of use of each domain and distribution of number of domains used by participants
- Principal component analysis to determine how domains group together (to define clusters of domains) (note: validity will be tested using split half method, or similar)
- Radar charts to be used to visualise differences between groups (demographics) and clusters (as defined by PCA), with percentage of strategies used in a domain as the variable
- Do the strategies, domains and clusters used vary based on demographic characteristics of participants (education, socioeconomic status, ethnicity, gender, age)?

Associations between strategy use at baseline and weight change at 3 months

Using standard regression model, test association between weight at 3 months (adjusted for baseline weight, complete cases only (e.g. participants who answered all questions at baseline and provided weight at baseline and at 2 ½ - 3 ½ months) and:

- Clusters of strategies (as determined using PCA above)
- Clusters of domains (as determined using PCA above)
- Individual domains (defined as percentage of strategies used within a domain AND as using at least one strategy within a domain)
- Number of domains used (number of domains in which a participant uses at least one strategy)
- Number of strategies used

Other possible analyses (TBC, do not need to be decided now and will not be included in JHB DPhil)

- Test-retest of cluster analyses – e.g. do you get the same clusters at a second point (for example, between first and second round of answers given?)
- Longitudinal analyses looking at change in strategy use over time, and how this associated with weight change (being left for time being as probably too complicated to be a component of JHB DPhil analysis, but definite possibility for further analysis)

Appendix 3. MoSCoW list for browser-based application for recording weight and use of behavioural weight management strategies (Chapter 4)

Contributors	Date	Changes
Jamie Hartmann-Boyce	17 July 2014	First draft following meeting with CV, LT, PA and JHB 14.7.14

A brief description of the questionnaire:

Currently there is a list of approximately 120 questions. This may change slightly before launch but the final number is likely to remain similar. Questions are classified in two ways: by **domain** (which represents behaviour type, for example, self-monitoring; there are 15 domains in total) and by **cross-classification** (diet; physical activity; or general, which cut across the various domains).

For the most part, the questions are unrelated and do not follow a logical order. However, there are some questions which, if a participant says 'no' to, **preclude** asking other questions. Two of these are screening questions, which are not part of the questionnaire itself. These refer to use of diet and physical activity to lose weight.

The questions will be grouped in **batches** of 10. Between every batch, a user will be asked if they are happy to answer the next batch.

(MUST) about the format

- A browser-based version of the weight loss questionnaire programme **MUST** be available at study start (web app).
- The browser-based version **SHOULD** be available as an application with an icon that users can save to their mobile phone.
- The web app **MUST** be available in both computer and mobile-optimised versions.
- The web app **MUST** work across all common desktop, laptop, tablet and mobile browser systems.
- In the mobile optimized version, one question **SHOULD** be displayed per page. In the desktop/laptop version, more than one question **COULD** be displayed on each page.
- Software based app versions **SHOULD** be available further down the line.
- Participants **SHOULD** be able to register interest in downloading the relevant software-based app when it becomes available.

(MUST) about the content

- The application **MUST** be able to present questions to the participant
- The application **MUST** have a feature by which users can enter their weight.
- The application **MUST** have automated algorithms that decide which questions to ask
- Additional questions **MUST** be added if requested by the research team
- Existing questions **MUST** be removed or amended if requested by the research team.
- Users **MUST** be able to answer as many questions as they want, whenever they want to answer questions.
- After completing a batch of questions, a user **SHOULD** be asked if they would like to answer more questions.
- If a user stops halfway through a batch of questions, the user **SHOULD** be entered into the same spot in that batch when they next logon.
- Questions **SHOULD** be asked at random, but **MUST** be asked within the following parameters:
 - users **WON'T** answer questions that previous answers have indicated are irrelevant to them (e.g. if a user indicates they are *not* trying to lose weight through physical activity, they **WON'T** be asked questions about physical activity unless they change their settings to indicate they are using physical activity)
 - Users **SHOULD** be asked 10 questions at a time, and then will be given the option to answer more or navigate away
 - users **MUST** be asked all questions that are relevant to them once before any questions are repeated
 - once users have answered all questions, each subsequent batch of 10 questions **SHOULD** be composed of 5 questions that the user has previously said 'yes' to and 5 questions that are chosen at random
 - within a batch of 10 questions, users **WON'T** be asked more than 3 questions relating to the same domain
 - Users **MUST** be informed at study start about why we are asking the questions in this way
- From all pages on the site, the user **MUST** be able to access the help menu.
- The help menu **MUST** include ways to report problems and ways to withdraw from the study. The help menu **SHOULD** include instructions for entering weight and the participant information sheet. The help menu **COULD** include a frequently asked questions page.
- From all pages on the site, the user **MUST** be able to browse to other sections. This **COULD** be done using tabs along the top of the screen. This **SHOULD**

include questions, entering and viewing personal weight data, viewing crowd data, user settings, and help.

(MUST) about user engagement outside of application

- User engagement **MUST** be encouraged through automated e-mails and text messaging
- Messages sent via social media **COULD** also be used to encourage engagement.
- Messages **SHOULD** include tailored messages to encourage use, including birthday messages and messages about duration of their own use of the app.
- Users who have not entered data in the last 4 days **SHOULD** be sent a reminder via e-mail and/or SMS

(MUST) about feedback to users

- The application **MUST** capture what feedback was given, when
- The application **MUST** display a graph of participants' weight. There **COULD** be an option for participants to map these weight changes against the domains of strategies the participant is using.
- Users **MUST** be able to see what strategies they have been using. They **SHOULD** be able to click into individual domains to see what strategies they have used within that domain.
- Users **SHOULD** be able to select the time period over which they are viewing their weight change graph.
- The application **COULD** provide users with feedback about the correlation between their own weight change and the strategies they have indicated using.
- The application **MUST** use data from other participants to provide feedback on correlations between specific strategies and weight loss (based on data from all users).
- The application **COULD** compare the strategies a user is using with those used by other users

(MUST) about user experience

- The application **WON'T** show error messages
- The application **MUST** provide actions to perform (to correct errors the application experiences)
- The browser-based programme **WON'T** freeze when a users' internet access is disrupted
- The application **MUST** provide instructions about self-weighing and use of the application

- There **MUST** be an automated system by which users can retrieve their username and password through entering their e-mail address
- The application **MUST** prompt users to enter their weight if they have not done so in the time periods specified by the study (2, 4, 6, 8, 10, 12 weeks from baseline, and then every 4 weeks thereafter)
- The application **MUST** allow users to enter weight data whenever they like
- Users **MUST** be able to change their settings whenever they like
- The application **SHOULD** be flexible to structural changes as requested by the research team, especially to increase retention if initially it is very low.

(MUST) Communications to the remote server.

- The app **MUST** transfer information directly to the server securely (SSL, RSA, ...)

(MUST) about data processing

- The application **MUST** record user logins, user weight, and answers to individual questions.
- The enrolment website/application **MUST** be able to handle a large amount of traffic at study start. This **COULD** be handled by a gradual roll out (e.g. participants register interest and are alerted when they can use it) but preferably everyone would be able to register and enrol immediately.
- The correlation between weight change and use of individual strategies and domains **MUST** be calculated.
- The application **SHOULD** record other usage data not directly relevant to weight and behaviour outcomes; e.g. “stickiness”, device from which the application is accessed, correlation between reminders and logins.

Appendix 4. Instructions for usability testing (Chapter 4)

Dear «Name»,

Thanks so much for volunteering to help out with testing of the web application we're developing for our weight loss study. I'm happy to say the site is now ready for testing. Some further details are listed below, and if you have any questions at all don't hesitate to ask – you can reach me on jamie.hartmann-boyce@phc.ox.ac.uk or on 01865 289 206 (though note I am out of the office 6-11 November, inclusive, so won't be answering the phone then).

Thanks again!

Jamie

Testing notes

Some general notes

- Please log in at least twice a week (for at least 5-10 minutes a time) during the month of November (in return you will get a grocery voucher as promised)
- The site is very much still under development, and various features and design elements will be added over the course of the month. We may want you to specifically test some of the new additions, and will e-mail you if this is the case. But generally, if you see things changing, or think it looks a bit plain at the moment, that's to be expected!

Registering

- The website can be accessed at: <https://edge.oxnet.nhs.uk/oxfab/>
- You'll need to register the first time you visit the site – it will ask you to tick a box saying 'I have problems with my weight' – even if this isn't the case please could you tick yes, as otherwise you won't be able to access the full content (this button will be removed in due course)
- Once you've registered, you'll be sent an e-mail with your login details

Comments

- Any comments, no matter how small, are appreciated, so don't hold back! Definitely let us know if something isn't working, but also let us know if you have any suggestions on ways we could improve the site.
- When you are in the site itself, you should see an orange button on the left of the screen that says 'feedback.' If you want to make a comment or report a problem, please click this button and enter as much description as you feel appropriate. It will automatically record what page you were on and what you were seeing when you pressed that button, so this is the best way to report an issue.
- If you have a more general issue, or think of something you want to feed back on after you've left the page, that's no problem – just e-mail me with the details (jamie.hartmann-boyce@phc.ox.ac.uk).

Appendix 5. OxFAB website screenshots (Chapter 4)

Home page



The first phase of the OxFAB study has closed, so we don't need you to log in at the moment for research purposes. You're welcome to continue to use the website until the end of the year.



WELCOME TO OxFAB

Researchers at the Nuffield Department of Primary Care Health Sciences, University of Oxford, are conducting a study to learn more about the strategies that people use when they are trying to lose weight. If you are interested in being involved, please enter your e-mail address below. If you have any questions, don't hesitate to contact us at oxfab@phc.ox.ac.uk. For further information about the study, visit our [FAQ](#).



REGISTER FOR OxFAB

If you are interested in being involved in the study, please click Register.



LOGIN TO OxFAB

Enter your credentials to log into the OxFAB system.

☐ Keep me logged in (for 2 weeks)



[I forgot my password](#)
[I forgot my username](#)

This research is funded by the National Institute for Health Research School for Primary Care Research (NIHR SPCR) and Nuffield Institute for Health Research Collaboration for Leadership in Applied Health Research and Care (NIHR CLAHRC) Oxford at Oxford Health NHS Foundation Trust.





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Note, this notification re: the study being closed was added after the study ended, and would not have been present for users interacting with the website over the course of the study.

This footer can be seen on every page of the study website, including funder acknowledgement, logos, social media links and links to relevant policies.

Prompt to enter weight



?

ANSWER QUESTIONS

RECORD WEIGHT

VISUALISE MY DATA

SETTINGS

LOGOUT

The first phase of the OxFAB study has closed, so we don't need you to log in at the moment for research purposes. You're welcome to continue to use the website until the end of the year, and will be able to download your weight data by clicking on [this link](#).

HOW MUCH DO YOU WEIGH?

Take the time and record your weight, it's simple, just click/tap/press on the "Record weight" link on the navigation bar or [click here](#).

If you don't know how much you weigh: in the past month, have you:

Lost weight

Stayed about the same

Gained weight

SAVE VALUE

Once a participant logs in, every page has the option to log out, submit feedback, answer questions, record weight, visualise data, and review settings.

feedback

This is the page a user would see upon logging in if they had not entered their weight in the past three months. If weight had been entered recently, participants would be directed to the 'answer questions' page on logging in.

Record weight page

 OXFORD FOOD & ACTIVITY BEHAVIOURS

ANSWER QUESTIONSRECORD WEIGHTVISUALISE MY DATASETTINGS

LOGOUT

The first phase of the OxFAB study has closed, so we don't need you to log in at the moment for research purposes. You're welcome to continue to use the website until the end of the year, and will be able to download your weight data by clicking on [this link](#).

Hi testjamie.
Please tell us about your current weight...

Feedback

Weight as st/lb

st

e.g. 10

lb

e.g. 6

Weight as kg

kg

e.g. 34.6

Date

18/08/2016

SAVE VALUE

User has option to enter today's weight or enter weight retrospectively – this happened in some cases, where users would return from holiday and log their weight.

Visualise my data (usage and weight)



?

ANSWER QUESTIONS

⚖️

RECORD WEIGHT

📊

VISUALISE MY DATA

⚙️

SETTINGS

LOGOUT

The first phase of the OxFAB study has closed, so we don't need you to log in at the moment for research purposes. You're welcome to continue to use the website until the end of the year, and will be able to download your weight data by clicking on [this link](#).

Hi testjamie.

You can visualise your data on a graph here...

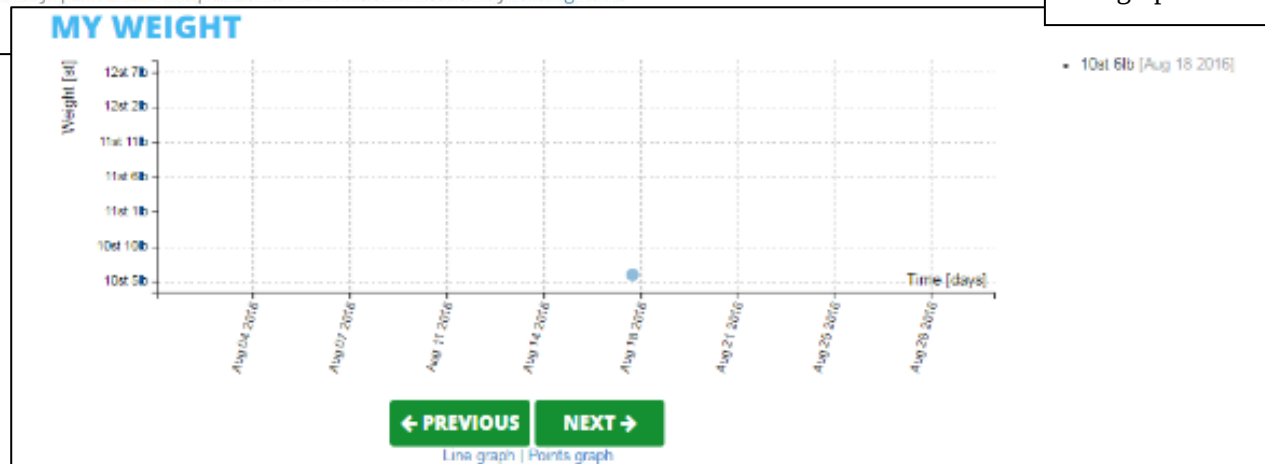
feedback

MY USAGE MY STRATEGIES MY WEIGHT

MY USAGE

You last answered questions Today. You have been part of this study for 604 days and have answered 53 questions. Thank you! It seems you haven't answered any questions in the past week. You can answer some by clicking [here](#).

Weight can be viewed as stone/pounds or in kg; previous or next takes user backward or forward in time; graph viewable either as discrete points or as line graph.

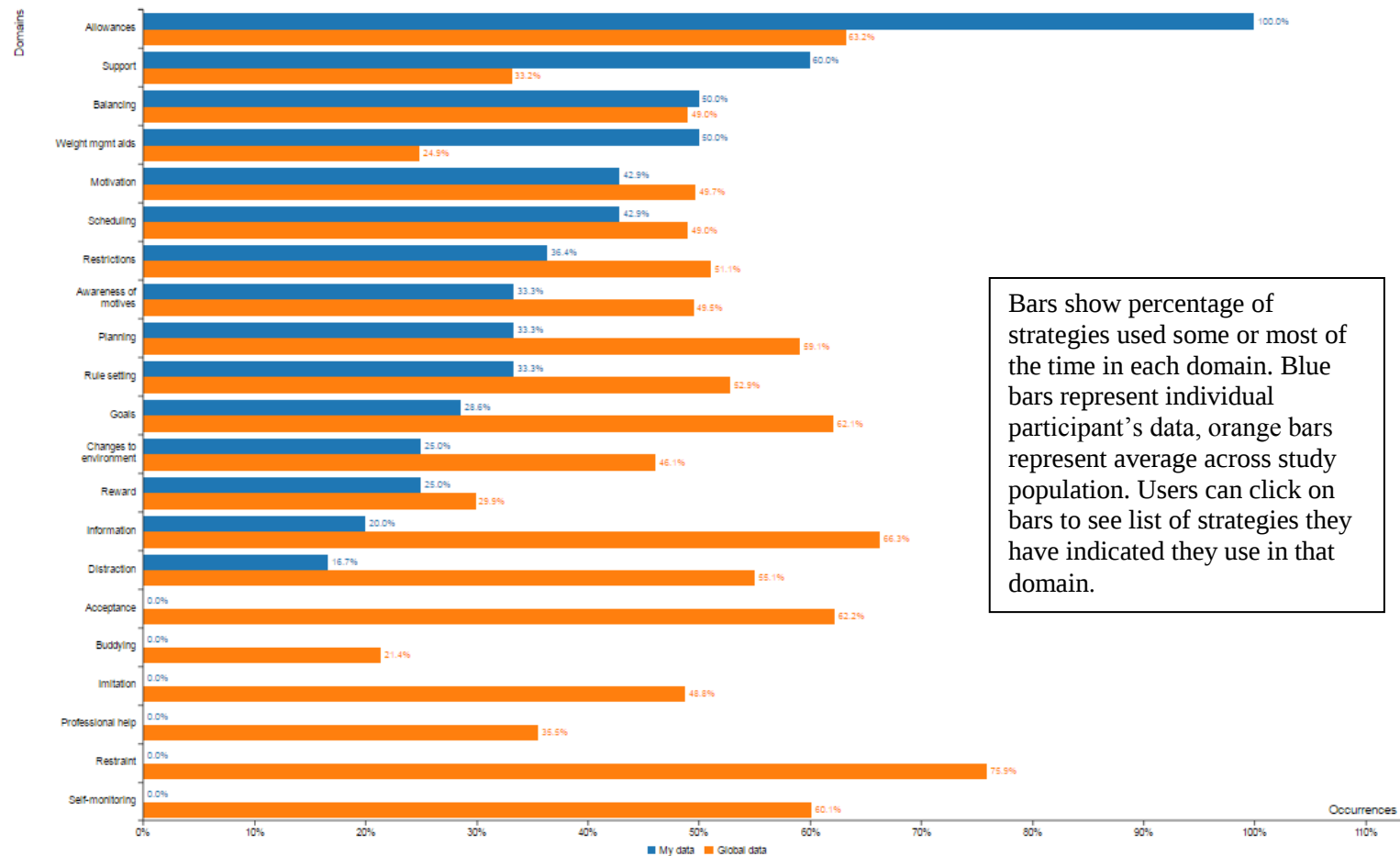


Visualise my data (my strategies)

MY STRATEGIES

Your top strategy domains are: Allowances, Support, Balancing.

Click on the bar to see which strategies you are using within each domain



Answer questions page

OxFAB
OXFORD FOOD & ACTIVITY BEHAVIOURS

ANSWER QUESTIONS RECORD WEIGHT VISUALISE MY DATA SETTINGS

The first phase of the OxFAB study has closed, so we don't need you to log in at the moment for research purposes. You're welcome to continue to use the website until the end of the year, and will be able to download your weight data by clicking on [this link](#).

Hi testjamie, welcome back!
Please answer the following questions...

1. I avoid eating in certain settings or at certain times of day as a way to help me lose weight (e.g. in front of the television, on the go, late at night)

Most of the time Sometimes Never or hardly ever Not relevant to me Unclear

2. If I feel like eating but am trying not to, I chew gum, drink something, or brush my teeth to stop me from doing so

Most of the time Sometimes Never or hardly ever Not relevant to me Unclear

3. I use the tightness of my clothes or rings to keep track of my weight

Most of the time Sometimes Never or hardly ever Not relevant to me Unclear

10. I adjust how much I eat depending on how much physical activity I've done or plan to do

Most of the time Sometimes Never or hardly ever Not relevant to me Unclear

Do you want to answer another set of questions now?

YES PLEASE **NO THANKS**

This research is funded by the National Institute for Health Research School for Primary Care Research (NIHR SPCR) and National Institute for Health Research Collaborator for Leadership in Applied Health Research and Care (NIHR CLAHRC) Oxford at Oxford Health NHS Foundation Trust.

OXFORD DEPARTMENT OF PRIMARY CARE HEALTH SCIENCES

NHS National Institute for Health Research

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Like 334K 121

Each question page displays 10 questions, the order for which is driven by a computerized algorithm which randomly selects questions, blocking by date last answered. For each question, user can select most of the time, sometimes, never or hardly ever, not relevant to me, or unclear. If 'unclear' chosen, user asked to provide further feedback.

After a user answers ten questions, they are given the option to answer another set of 10 questions. This design was chosen to diminish the burden felt by participants in light of the large number of questions in the question bank.

Settings

Weather WebLearn : Graduate SCOPE CLAHRC sharepoint Stata Class Notes: M Stata FAQ: How can I Qual training Regression with Stata

OxFAB
OXFORD FOOD & ACTIVITY BEHAVIOURS

ANSWER QUESTIONS RECORD WEIGHT VISUALISE MY DATA SETTINGS

The first phase of the OxFAB study has closed, so we don't need you to log in at the moment for research purposes. You're welcome to continue to use the website until the end of the year, and will be able to download your weight data by clicking on [this link](#).

Hi testjamie.
Configure your account here...

[Edit account information] [Edit my personal details]

SCREENING QUESTIONS

Your answers to the questions below will determine which strategies you are asked about. Please update your answers if they have changed.

This questionnaire is only designed for people who are overweight or obese and are currently trying to lose more than a few pounds (or kilograms) during a sustained attempt to lose weight. Does that describe you?

☐ No ☒ Yes

How old are you?

yrs 20

Do you do the food shopping for yourself/your household?

☐ No ☒ Yes

Do you currently live in the UK?

☐ No ☒ Yes

Are you trying to exercise or be more active as a way to lose weight?

☐ No ☒ Yes

Are you changing your diet as a way to lose weight?

☐ No ☒ Yes

SAVE ANSWERS

OTHER SETTINGS

Do you prefer your weight displayed as:

☐ kilograms ☒ stones/pounds

SAVE ANSWERS

At any time, a user can edit their settings, including screening questions, personal details, and account settings (username, email, and password)

MY PERSONAL DETAILS

Details on this page used to establish baseline demographics

Are you willing to be contacted for future research of this type?

☒ Yes ☐ No

Gender

☒ Male ☐ Female

Height

ft 5

in 7

cm 170

Ethnicity

White British/Irish

What is the highest level of education that you have completed?

University degree

First part of your postcode (e.g. Full postcode OX3 7DQ, First part OX3)

OX1

How did you hear about this study?

Other

SAVE ANSWERS

Screening questions relate both to determining eligibility (age, location) and which questions a user will be asked (diet, exercise, food shopping)

CHANGE USERNAME

New username
(username cannot be empty, and must be alpha200 and 2-46 characters)

(currently: testjamie)

CHANGE USERNAME

CHANGE EMAIL

New email

(currently: jamie.hartmann-boyce@ghc.ox.ac.uk)

CHANGE EMAIL

CHANGE PASSWORD

Your OLD Password

New password

Repeat new password

CHANGE PASSWORD

Frequently asked questions (FAQs)



OXFORD FOOD & ACTIVITY BEHAVIOURS

REGISTER / LOGIN

4. Questions about the study

1. QUESTIONS ABOUT THE QUESTIONS

HOW MANY QUESTIONS ARE THERE IN TOTAL?

The number of questions you will be asked depends on your answers to previous questions. We are interested in what you do and how this changes, so you will be asked questions more than once to see if what you are doing changes over time. You will never be asked the same question twice in one day, but you may well be asked the same question a few days apart. You don't have to answer all of the questions in one sitting.

HOW OFTEN SHOULD I LOG IN AND HOW MANY QUESTIONS SHOULD I ANSWER EACH DAY?

This is up to you. We recommend that you log in at least twice a week for at least three months and answer as many questions as you feel like answering each time – it could be just 10, or it could be 100. The more you log in and the more questions you answer, the more researchers can learn about ways that people can manage their weight.

WHAT DO THE DIFFERENT ANSWER OPTIONS MEAN?

Most questions have the below answer choices. For each one, please indicate:

- Most of the time if you're doing this regularly to manage your weight
- Sometimes if you do this occasionally to manage your weight
- Never/ hardly ever if you aren't doing this, or have only done it once or twice
- Not relevant to me if the question doesn't apply to you (for example, it's about working at a desk and you don't work in an office, or it's about alcohol and you don't drink)
- Unclear if you aren't sure what the question is asking

WHAT DO I DO ONCE I'VE ANSWERED QUESTIONS?

When you are done, please click 'save answers' to be asked more questions or 'submit and exit' if you are done answering questions for the time being.

I'M DOING SOMETHING TO MANAGE MY WEIGHT BUT THE QUESTIONNAIRE HASN'T ASKED ME ABOUT IT

If there's something you are doing to lose weight, but you haven't been asked about it, feel free to e-mail us at oxfab@phc.ox.ac.uk and let us know.

YOU'RE ASKING ME TO ENTER MY WEIGHT BUT I DON'T KNOW IT

So that researchers can look at the relationships between weight change and the strategies people are using to manage their weight, the website will ask you to report your weight occasionally. If you don't know your weight, there is an option to indicate if, over the past month, you feel you have lost weight, gained weight, or stayed the same. If you do know your weight, please enter it either as stone or kg.

WHAT DO YOU MEAN WHEN YOU ASK ABOUT 'DIET'?

Diet can be anything you eat or drink, whether or not you are doing so to manage your weight. However, when we ask about 'your diet' or 'dieting' in these questions we specifically mean the dietary plan or pattern that you are trying to follow to manage your weight. We know that the real definition of diet is much broader, but we couldn't find another short and simple way to say "meal plan that you are trying to follow to manage your weight"!

FAQs added to throughout study
in response to participant
feedback

FAQs, cont.

2. QUESTIONS ABOUT SETTINGS

HOW DO I TURN ON OR TURN OFF EMAIL REMINDERS?

You can choose how often, if at all, you want to be reminded to login to the site if you haven't logged in recently. Go to '[settings](#)' and scroll down to 'other settings'. You can choose if you would like to be contacted daily, every 3 days, every 6 days, or not at all.

HOW DO I SEE MY WEIGHT?

To see a graph of your weight, go to '[visualise my data](#)'. The graph contains all the weight values since you signed up for the study, and you can click 'next' or 'previous' to go forward and back in time. To choose whether your weight is displayed as stone/pounds or as kilograms, go to [settings](#), 'other settings'.

HOW DO I SEE WHAT STRATEGIES I'M USING?

To see a graph of the strategies you are using, go to '[visualise my data](#)'. The graph called 'my strategies' shows you how many strategies you are using in each group of strategies (domain). Within each domain, if you click on the top bar you can see what strategies you have reported using. The percentage you see is the number of strategies in a domain that you use, and the 'global data' is the average number of strategies per domain that everyone in the study uses.

I'VE STARTED OR STOPPED USING DIET OR EXERCISE TO MANAGE MY WEIGHT SINCE I FIRST ENTERED THE STUDY

If you indicated at the start of the study that you aren't trying to change your diet as a way to lose weight, you won't be asked any questions about diet (for example). If this changes over the course of the study, go to '[settings](#)' and change your answers under 'screening questions.'

3. PROBLEMS WITH THE SITE

HOW DO I REPORT A PROBLEM?

You can click 'feedback' to tell us if something on the site isn't working. You can also contact us using the information on the '[contact us](#)' link.

FAQs, cont.

4. QUESTIONS ABOUT THE STUDY

WHAT DOES THE STUDY INVOLVE?

Researchers at the University of Oxford are looking for people who are currently trying to lose weight through diet and/or exercise to take part in a study to consider the behaviours people use to manage their weight. The study involves logging into a website as frequently as you like (ideally at least once a week), for as long as you like (ideally for at least three months). When you log in, you will be asked to answer questions about strategies you are using to lose weight. Each session can take as little as five minutes, though you can choose to answer additional questions if you wish. You will also be asked to report your weight. You will be able to review which strategies you are using and see what strategies other people are using. If you are interested in participating please enter your e-mail address on the home page (www.oxfab.org). If you have any questions or would like to learn more about the research, please contact Ms Jamie Hartmann-Boyce on oxfab@phc.ox.ac.uk or on 01865 289 206.

ABOUT THE RESEARCHERS

This study is being led by members of the [Behavioural Medicine](#) team in the Nuffield Department of Primary Care Health Sciences, University of Oxford. The team working on the OxFAB study includes [Paul Aveyard](#), Professor of Behavioural Medicine, [Susan Jebb](#), Professor of Diet and Population Health, and [Jamie Hartmann-Boyce](#), who is working towards a PhD.

I DON'T WANT TO BE INVOLVED IN THE STUDY ANY MORE

You can withdraw from the study at any time without penalty and without giving a reason by telling the researchers that you no longer want to be involved. Please visit the 'contact us' link.

I HAVE A CONCERN ABOUT THE STUDY

If you have a concern about any aspect of this project, please contact Jamie Hartmann-Boyce or Paul Aveyard via the mail or email address on the '[contact us](#)' page. Jamie or Paul should acknowledge your concern within 10 working days and give you an indication of how they intend to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the chair of the Research Ethics Committee at the University of Oxford (Chair, Medical Sciences Inter-Divisional Research Ethics Committee; Email: ethics@medsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD). The chair will seek to resolve the matter in a reasonably expeditious manner.

Participant information sheet

Prior to seeing this page, a new participant would have:

- > Entered username, password and email address by following registration link on homepage
- > Been emailed an activation link which directed to this page

INFORMATION ABOUT THIS STUDY

You are being invited to take part in this study because you indicated you are trying to lose weight through diet, exercise, or both. We are conducting this research to help us find out more about what behaviours people use to manage their weight (for example, recording how much they weigh or what they eat, exercising with someone else, setting themselves goals) and how these might be related to weight loss success.

If you decide to participate in this study, you will be asked to logon to the OxFAB website and answer questions about what strategies you are using to try to lose weight. Sessions can last for as little as five minutes, and ideally we'd like you to log on at least twice a week for three months. You can also track your own weight on the website, and occasionally we'll ask you to report your weight. You will also be able to review the strategies you are using, and to see what strategies other people in the study are using. You can log on to the website whenever you want, and can choose whether or not you'll be sent reminders about logging in.

You can ask questions about the study before you decide whether to participate. You can choose whether you take part or not, and if you choose to take part, you can withdraw from the study at any time without penalty and without giving a reason by telling the researchers that you no longer want to be involved. Researchers from the University of Oxford will have access to your answers to the questions. Your answers will be stored along with some facts about yourself (how old you are, your gender, your ethnicity and your highest level of education) but will not be stored with data that could identify you.

If you agree to participate in this project, some of the research will be written up as a thesis, produced to get a degree from Oxford. It will not contain any details that would identify you. The thesis will be deposited both in print and online in the University archives, and will be available to every internet user.

This study is intended to help us find out more about what people can do to lose weight. Some of the questions may help you to think of actions which may help you in your weight loss efforts and you will be able to see the strategies that other people are using. There are no risks from being involved in this study.

This study has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee. If you have a concern about any aspect of this project, please contact Jamie (oxfab@phc.ox.ac.uk, address above), or her supervisor, Professor Paul Aveyard (paul.aveyard@phc.ox.ac.uk, address above). Jamie or Paul should acknowledge your concern within 10 working days and give you an indication of how they intend to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the chair of the Research Ethics Committee at the University of Oxford (Chair, Medical Sciences Inter-Divisional Research Ethics Committee; Email: ethics@medsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD). The chair will seek to resolve the matter in a reasonably expeditious manner.

Participant consent

CONSENT TO BE INVOLVED IN THIS STUDY

The purpose of this study is to help researchers find out more about what behaviours people use to manage their weight and how these might be related to weight loss success. Eventually, we hope this research will help us learn more about what people can do to lose weight on their own or with the help of others.

If you are happy to be involved in this study, please click the below 'I agree' button to acknowledge that you:

- Have read the participant information above;
- Have had the opportunity to ask questions about the study and have received satisfactory answers to the questions, and any additional details you've requested;
- Understand that the study has been reviewed by, and received ethics clearance from, the University of Oxford Central University Ethics Committee;
- Understand who will have access to the personal data provided, how the data will be stored, and what will happen to the data at the end of the project;
- Understand how data included in the thesis will be published and stored;
- Agree to participate in the study;
- Understand that you may withdraw from this study at any time without giving reason and without penalty;
- Understand how to raise a concern and make a complaint.

I AGREE

I DO NOT AGREE

After consenting, participant directed to settings page to enter personal details

OxFAB

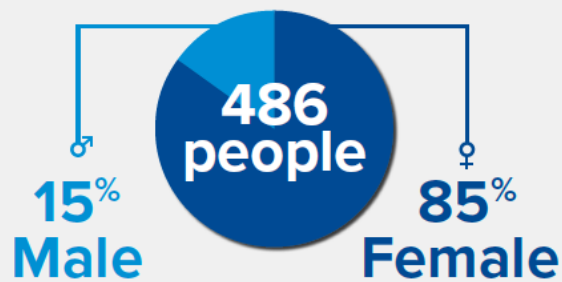
OXFORD FOOD & ACTIVITY BEHAVIOURS

Our preliminary findings.

The OxFAB study aimed to learn more about the different strategies that people use when they are trying to lose weight.

We've a long way to go, crunching the numbers and working to understand the data properly, but we wanted to give you a summary of what we've seen so far.

Who completed the survey?



How much weight did they lose (after 3 months)?



About the weight of a Yorkshire Terrier

End of study graphic, cont.



End of study graphic, cont.



End of study graphic, cont.



The graphic is a thank-you message for the OxFAB study. It features a green banner at the top with the text "...and finally...". Below this, on the left, is an illustration of two blue balloons. To the right of the balloons, the text "Thank you!" is written in a large, bold, green font. Below "Thank you!", the text "Without your help OxFAB would not have been possible!" is written in a smaller, blue font. At the bottom of the graphic, there are two logos: the University of Oxford logo on the left and the NHS National Institute for Health Research logo on the right. Below the logos, there is a block of text providing funding information and a disclaimer.

...and finally...

 **Thank you!**

Without your help OxFAB would not have been possible!

OxFAB is funded by the National Institute for Health Research (NIHR) **School for Primary Care Research (SPCR)** and the NIHR **Collaboration for Leadership in Applied Health Research and Care (CLAHRC)** Oxford at Oxford Health NHS Foundation Trust.

The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.

OxFAB is led by the Behavioural Medicine team in the Nuffield Department of Primary Care Health Sciences, University of Oxford. The team working on the OxFAB study includes Paul Aveyard, Professor of Behavioural Medicine, Susan Jebb, Professor of Diet and Population Health, and DPhil candidate Jamie Hartmann-Boyce.

Appendix 7. MEDLINE search strategy for qualitative review (Chapters 5 and 6)

Run in MEDLINE 9 December 2015

1	Obesity/ or Obesity, Morbid/ or Obesity, Abdominal/
2	Overweight/
3	(overweight or over weight or overeate* or over eat* or overfeed* or over feed*).ti,ab.
4	obes*.ti,ab.
5	Weight Loss/
6	(weight adj2 (gain* or los* or reduc*)).ti,ab.
7	1 or 2 or 3 or 4 or 5 or 6
8	Obesity/dh
9	Obesity, Morbid/dh
10	Overweight/dh
11	Obesity, Abdominal/dh
12	Diet Therapy/
13	Diet, Reducing/
14	Diet, Fat-Restricted/
15	Dietetics/ed, mt
16	(diet or diets).ti,ab.
17	(low calorie or hypocaloric or calorie control*).ti,ab.
18	(health* adj1 eating).ti,ab.
19	(diet* adj2 (modific* or therapy or intervention* or strateg* or program* or management or scheme*)).ti,ab.
20	(nutrition adj2 (modific* or therapy or intervention* or strateg* or program* or management or scheme*)).ti,ab.
21	exp exercise/
22	exp Exercise Therapy/
23	(exercise and (therapy or therapies or activity or activities or program* or scheme*)).ti,ab.
24	(walk* or step* or jog* or run* or bicycl* or cycle* or cycling).ti,ab.
25	(aerobic* or physical therap* or physical activit* or active travel* or active transport* or active commut*).ti,ab.
26	(fitness adj (class or regime* or program* or group* or session* or scheme*)).ti,ab.
27	(reduc* adj2 sedentary behavio?r).ti,ab.
28	behavio?ral intervention*.ti,ab.
29	(lifestyle adj2 (chang* or modific* or therapy or intervention* or strateg* or program* or management or scheme*)).ti,ab.
30	lifestyle/
31	behavior therapy/
32	health behavior/
33	8 or 9 or 10 or 11 or 12 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34	exp Internet/
35	Electronic Mail/
36	Therapy, Computer-Assisted/
37	Webcasts as Topic/
38	(internet or www* or web or computeri?ed or web-based or net or online or podcast* or webcast* or video* or blog*).ti,ab.
39	(listserv* or "list serv*" or "list-serv*" or "mailing list*" or e-mail* or email*).ti,ab.

40	(discussion adj2 (group? or forum?)).ti,ab.
41	cellular phone/ or text messaging/
42	("mobile phone" or "mobile phones" or "cell phone" or "cell phones" or "cellular phones" or "cellular phone" or text messag* or txt or pxt or sms or mms or app or iphone* or "android phone*").ti,ab.
43	Self Care/
44	Manuals as Topic/
45	patient education as topic/
46	health education/
47	consumer health information/
48	Bibliotherapy/
49	(self help or self manag* or self care or self change or self directed or bibliotherap* or manual? or information aid? or leaflet? or booklet? or pamphlet? or brochure? or workbook? or work-book?).ti,ab.
50	Self-Help Groups/
51	34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50
52	7 and 33 and 51
53	*Weight Loss/
54	*Diet, Reducing/
55	(weight and (lose or loss or losing or control or maint* or manage*)).ti.
56	dieting.ti,ab.
57	slimming.ti,ab.
58	("going on a diet" or "being on a diet").ti,ab.
59	53 or 54 or 55 or 56 or 57 or 58
60	52 or 59
61	interviews.mp,pt. or qualitative.mp. or experiences.tw.
62	60 and 61
63	(Qualitative systematic review* or (systematic review and qualitative)).ti,ab.
64	(evidence synthesis or realist synthesis).ti,ab.
65	(Qualitative and synthesis).ti,ab.
66	(meta-synthesis* or meta synthesis* or metasynthesis).ti,ab.
67	(meta-ethnograph* or metaethnograph* or meta ethnograph*).ti,ab.
68	(meta-study or metastudy or meta study).ti,ab.
69	systematic review*.ti,ab. and qualitative research/
70	63 or 64 or 65 or 66 or 67 or 68 or 69
71	60 and 70