UNIVERSITY OF LIVERPOOL

Identifying the theoretical mechanisms of Motivational Interviewing within weight-related behaviour change in obesity: a multi-methods investigation.

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy by Harriet Elizabeth Makin.

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DECLARATION IN HIGHER DEGREE THESIS

DECLARATION

This thesis is the result of my own work. I designed the research in conjunction with my supervisory team and was responsible for data collection, analysis, and write-up. The material contained in the thesis has not been presented, nor is currently being presented, either wholly or in part for any other degree or qualification.

Signed  (candidate)

Contents

Abstract

This thesis used a multi-methods, sequentially designed approach to examine the theoretical mechanisms of Motivational Interviewing (MI). Chapter 1 provides an overview of the existing literature and relevant concepts within the area of obesity and behaviour change. Chapter 2 describes the methods used within the research studies. Chapter 3 is a systematic review and meta-analysis of the existing literature base exploring the effectiveness of MI within the context of obesity and weight management outcomes. Chapter 4 used a qualitative, cross-sectional design to elicit the perspectives of healthcare professionals with experience of supporting behaviour change, to further understanding about the effectiveness of behaviour change approaches. Chapter 5 and Chapter 7 explore the effectiveness and components of MI through interventional studies using single-group and comparator designs. Chapter 6 presents the protocol for a randomised controlled trial as reported in Chapter 7. Chapter 8 discusses the findings of these research studies and makes recommendations for practice and research in light of the potentially effective techniques to support behaviour change within this context. Firstly, the findings suggested that there was generally poor reporting of intervention content within existing literature. This creates challenges in understanding the components of behaviour change interventions that may support patients in achieving desired outcomes. Secondly, healthcare professionals considered MI to have utility when applied to a range of behaviour change goals through supporting a deep understanding of the individual and their goals, and the formulation of specific and individualised plans. The findings of the interventional studies suggested potential for MI as an effective intervention to support physical activity increases and individual participant perceptions of progress towards their goals. In sum, this thesis demonstrates that MI may be a beneficial intervention for bodyweight-related behaviour change. Further research could be conducted to clearly establish and test the effectiveness of this complex intervention. There is scope for future research studies using a more specified approach to intervention content reporting that can establish clear, replicable and actionable techniques from behaviour change taxonomies.

Contributor's statement

In accordance with The University of Liverpool's guidelines for submission of thesis by published paper, this thesis conforms to an 'article format.' Chapters 3, 4, 5, and 7 are presented as articles. Chapter 3 is published. Chapters 4 and 7 are in preparation for publication. Each of these chapters is a discrete article, and therefore some literature is replicated between chapters.

Empirical work included in the thesis and summary of author contributions

Chapter 3 is published in Clinical Obesity as;

Makin, H., Chisholm, A., Fallon, V., & Goodwin, L. (2021).

The author contributions are;

HM conceptualised and developed the protocol, conducted literature searches, and all stages of article screening (title, abstract and full-text). HM conducted quality assessment and data extraction of included studies, developed the narrative summaries of data and conducted formal meta-analyses. HM drafted the manuscript and approved the final manuscript as submitted for publication. AC completed data extraction activities, reviewed and revised the manuscript, and approved the final manuscript as submitted. VF and LG supervised the protocol development, data extraction, analysis, interpretation and write-up of the work, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Chapter 4 is in preparation for submission to Patient Education and Counseling as;

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The author contributions are:

HM, VF, and LG conceptualised and designed the study protocol. HM collected the study data. All authors contributed to the analysis of study data and interpretation. HM drafted the initial manuscript with supervision from VF, LG, and AC.

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The author contributions are;

HM and AC conceptualised and designed the study protocol with input and advice from VF and LG. HM conducted participant recruitment, data collection and analysis, supervised by AC. HM designed and conducted the analysis with GH. AC, LG, and VF supervised the analysis. HM drafted the study write-up. All authors reviewed and revised the study manuscript, and approved the final manuscript as submitted.

Remaining chapters

Chapters 1 (Introduction), 2 (General Methods), and 8 (Discussion) were written by HM and reviewed by the supervisory team (VF, LG, and AC).

Chapter 5

Chapter 5 (intervention study 1) was conceptualised by HM, VF, and LG. HM designed the study protocol. HM collected the study data. HM completed data analysis. All authors contributed to the analysis of study data and interpretation. HM drafted the study report with supervision and review of drafts from VF, LG, and AC.

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List of tables

List of figures

Abbreviations

Table 1. Abbreviations used throughout thesis.

ACT	Acceptance and Commitment Therapy
AEBS	Addiction-like Eating Behaviour Scale
BCT	Behaviour Change Techniques
BCTTv1	Behaviour Change Technique Taxonomy version 1
BMI	Body Mass Index
CDC	Centers for Disease Control
COM-B	Capability, Opportunities, Motivation - Behaviour
IPAQ	International Physical Activity Questionnaire
MI	Motivational Interviewing
MIT	Motivational Interviewing Techniques
MITI	Motivational Interviewing Treatment Integrity
OARS	Open-ended questions, Affirmations, Reflections, Summaries
SES	Socioeconomic Status
TA	Thematic Analysis
WHO	World Health Organisation

Chapter 1. General Introduction

1.1. Prevalence

The health condition of obesity is characterised by excess adipose tissue, which is associated with an increased risk of further health complications including the development of Type 2 diabetes (Malik et al., 2013), cardiovascular disease (Ortega et al., 2016), non-alcoholic fatty liver disease (Fabbrini et al., 2010) and some types of cancer (Wolin et al., 2010). Various definitions of obesity for the purposes of healthcare are used. A Body Mass Index (BMI) of 30 points or greater is one such classification tool (World Health Organisation, 2021) which can be used as a format for screening patients to determine if there is a need for intervention (CDC, 2022). However, there have been criticisms of the use of BMI (kg/m^2) as a diagnosis tool as it does not discriminate between body fat and muscle (Adab et al., 2018) which may result in inappropriately high BMI scores for individuals with lower risk of the associated health outcomes. Alternative methods for classification of obesity are discussed further in section 1.9 and include the use of body fat percentage (Jensen, 2008). It is a complex, chronic, and multifactorial condition with numerous avenues of research investigating contributing features including biological, genetic and behavioural components (Choquet & Meyre, 2011; Clark et al., 2007; Goodarzi, 2018; Murray et al., 2014).

The global prevalence of obesity has increased across all ages (Williams et al., 2015).[1] Recent estimates are that 650 million adults are currently living with obesity, or around 13% globally (World Health Organisation, 2021), nearly tripling rates from 1975 to 2016. Around 177 million adults could be living with obesity by 2025 (World Health Organisation, 2021). Obesity has been associated with negative physical and mental health outcomes (Avila et al., 2015; Bhaskaran et al., 2014), increased

[1] Whilst BMI in children and young people is predictive of BMI at later life stages, childhood obesity is beyond the scope of the current thesis which will focus on behaviour change within adults living with obesity.

healthcare costs (Cawley & Meyerhoefer, 2012) and reduced economic participation (Hammond & Levine, 2010). As a result, current public health research and practice have highlighted the importance of tackling growing obesity rates (Ayton & Ibrahim, 2019). Reducing obesity rates is one component of the NHS Long Term Plan (NHS, 2019).

1.2. Causal mechanisms

Obesity is widely understood to present as a complex, multi-component and long-term condition that is the result of interactions between a wide range of factors (Malik et al., 2013). There are multiple approaches which contribute towards the development and maintenance of bodyweight. Weight management has been framed as both a personal and political responsibility (Lawrence, 2004), and approaches often target either individual factors such as exercise and diet education (Webb et al., 2017), and population-level intervention and policy changes, such as food taxes or subsidies (Faith et al., 2007). To identify the most appropriate interventions for obesity-related outcomes it is important to identify the contributing factors that lead to its development.

1.3. Biological approaches

Various physiological mechanisms are involved in bodyweight maintenance, loss, and gain. Set point theory argues that the body can regulate according to a predetermined level, which is carefully managed by energy intake and expenditure, issuing changes to metabolism and behaviour according to bodyweight (Müller et al., 2010). Stimuli such as a lack of food availability, increased calorie expenditure or low levels of satiety signalling hormones such as leptin drives the sensation of hunger, which motivates the individual to eat (Andermann & Lowell, 2017)

Within obesity, changes may occur to biological functions which mean the body does not regulate at a consistent bodyweight as initially specified (Farias et al., 2011). There are several components hypothesised to formulate the regulatory system, including the hormones leptin and ghrelin, brain regions including the hypothalamus, amygdala, and hippocampus (Müller et al., 2018). Support for the role of bodyweight homeostasis comes from the surgical findings of bariatric research. This has identified maintained lower bodyweights following procedures designed to intervene in the

mechanisms of this regulatory system (Hao et al., 2016). Research has also identified a role for neurotransmitters in facilitating appetite (Trayhurn, 2005). There are also genetic contributors to the individualisation of bodyweight gain, which have been frequently studied within rat models (Jou, 2014; Speakman et al., 2007).

There are several key concepts of appetite regulation that are important to highlight when summarising the current understanding of causal factors in obesity. Changes to the gastrointestinal system may result in altered signalling of ghrelin and leptin, which are both implicated in sending signals of satiety to the brain (Hellström, 2013; Yeung & Tadi, 2022). This is believed to result in increased eating as food intake does not reduce sensations of hunger (Llewellyn et al., 2014). There are also believed to be underlying genetic components to obesity which result in a heritable influence on appetite regulation and the storing of fat within adipocytes (Herrera & Lindgren, 2010). Some researchers have suggested that this has evolved as an advantageous trait following ancestor experiences of famine or food shortages (Neel, 1999). However, the health outcomes of excess body fat appear to outweigh the shorter-term benefits (Speakman, 2008) and do not regard the wider social and experiential determinants which can factor into the development of obesity (McDermott, 1998).

1.4. Environmental approaches

The lived environment has a wide range of impacts on health behaviours. Within bodyweight, overweight and obesity research specifically, many individuals are now thought to be impacted by the *obesogenic environment* (Kirk et al., 2010). The obesogenic environment is suggested to account for increased prevalence of obesity in industrialised settings through limited access to nutritionally dense, high-quality foods, more limited access to physical activity and sports, and more sedentary lifestyles (Jones et al., 2007). This is an important consideration in prevention and treatment efforts as much of the world are based within environments that have obesogenic properties.

The social and built environment are influential factors in the development of obesity as both a driver of an individual's behaviour (such as transport accessibility) and action and through direct exposure to stressors such as harmful substances (Frank et al., 2019). There was mixed evidence

regarding the impact of environmental factors in urban and rural areas with evidence supporting a stronger impact in either area, or no impact on overweight and obesity (Lam et al., 2021). Urban areas are believed to limit physical activity for reasons such as safety, poor pavement provision, and issues in the planning of street connectivity (Berrigan & Troiano, 2002). There was an increased risk of developing overweight or obesity in those who use cars as a form of transport in comparison to other methods of transportation, such as walking (Patil & Sharma, 2021). Physical activity is an important element of energy balance (Griera et al., 2007) and therefore if physical activity is not considered when the built environment is being developed, it may detrimentally impact on physical health. However, physical activity is only one component of the complex regulatory system of bodyweight, and physical activity has a relatively small impact on female bodyweight compared to male (Westerterp et al., 1992).

There are some social and environmental contributors in weight management that necessitated population-level intervention. For example, in some areas, minimal access towards supermarkets limited access to foods that are nutritionally supportive of good health. Highly processed food consumption is positively associated with overweight and obesity (Poti et al., 2017). There have been attempts to make structural improvement by enabling supermarket businesses to open in these areas. However, interventions to improve access to food via supermarkets in areas that had previously low or no access towards groceries do not appear to make significant changes to dietary habits (Cummins et al., 2014).

Sedentary lifestyles are associated with poorer health outcomes as a dose-response relationship (Katzmarzyk et al., 2009) for multiple conditions including cardiovascular disease, bone health, vascular health, and obesity (Tremblay et al., 2010). Globally, many adults are sedentary, which is the result of increased access to transport systems, recreational activities such as television and computer games, and more people working in desk-based employment (Choi et al., 2010) which has led to attempts to reduce occupational sitting as a workplace safety policy by breaking up sitting time (Straker et al., 2016).

It is most likely that obesity stems from a combination of factors including the role of the built environment. However, there was limited evidence that supports the theorised influence of the built environment on bodyweight due to overall small effects (Lam et al., 2021) and a paucity of high-quality studies investigating effects over time. Further longitudinal research is required to assess the physiological impact of exposure to environmental chemicals that are associated with disease burden (Frank et al., 2019). The impact of industrialisation also necessitates more research, as the impact of either rural or urbanised locations may be explained by socioeconomic factors, rather than the built environment (Peytremann-Bridevaux et al., 2007). The role of community environments in prevention efforts and population-level interventions has received plenty of attention, but the research evidence requires more carefully designed longitudinal studies to unpick the multiple determinants which may play a role in obesity development (Gordon-Larsen, 2014).

1.5. Social approaches

Social factors are determinants of health status (Braveman & Gottlieb, 2014). Early research identified social factors of obesity including increased prevalence within lower socioeconomic status (SES) groups (Goldblatt et al., 1965), and patterns of association between lower SES and increased bodyweight have become more similar globally over time (McLaren, 2007). More recently, regression models have identified that key determinants of overweight and obesity include lifestyle, diet, social status and sociodemographic factors such as education, employment and income (Klumbiene et al., 2004; Yen et al., 2009). Some research has pointed towards greater levels of obesity in higher socioeconomic status populations, whilst more research has identified greater levels of the condition in lower socioeconomic status populations (McLaren, 2007). Overall, there appears to be a pattern of lower SES associated with greater BMI (McLaren, 2007) although other social and cultural factors, such as pressure for the thin ideal are reported regardless of socioeconomic status (Stice et al., 2001).

Obesity may be an increased risk for those with lower levels of academic attainment, lower income levels and areas of increased deprivation comparative to the national average (Drewnowski, 2009; McLaren, 2007; Reidpath et al., 2002). Lower-income areas may also be associated with greater consumption of less healthful foods in family homes (Nackers & Appelhans, 2013). The mechanism

of social inequality within obesity is affected by more limited access to healthy foods, both physically and financially, and areas known as *'food deserts'* (Coveney & O'Dwyer, 2009). In these locations, energy-dense, high calorie food may be a more accessible source of sustenance than foods categorised as healthy and has been one area of focus for health policy implementation within the United Kingdom (Wrigley, 2002). A pre- post- study of sudden increase in food retail stores identified that there were modest improvements in dietary intake, suggesting there are other factors which contribute towards eating behaviour beyond the accessibility of healthy foods (Wrigley et al., 2003), and access to a car may be a more important contributor to food purchase choices than nearby retail (Wright et al., 2016). Reviews of relevant research have identified that fast food restaurants are predominantly placed in areas with higher concentrations of ethnic minority groups, although there was not conclusive evidence regarding the impact of fast-food access on body mass index (Fleischhacker et al., 2011). Furthermore, the presence of *food deserts*, at least within the United Kingdom, has been debatable and may be based on a small number of research studies (Cummins & Macintyre, 2002). Additional research is required to confirm the longitudinal impact of this on health outcomes and diet. However, it is important to take such characteristics into account when identifying effective interventions, to ensure it is appropriately tailored towards the population of interest (Smith et al., 2012).

The food environment is described as obesogenic within the literature. This means the food environment includes factors that contribute to the development of obesity. This can include the marketing of foods that are associated with increasing bodyweight, such as foods that are high in fat, sugar, and salt. Portion sizes have steadily increased, and as portion sizes are used as cues to determine the amount eaten, this influences overall food intake (Marteau et al., 2015). Therefore, increasing portion sizes represent one modifiable factor of eating behaviours. Reducing portion sizes has been found to decrease the amount of energy consumed out of the home (Reynolds et al., 2021). Research comparing food marketing (for example, labelling a food as light and healthy or indulgent and rewarding) affects subjective satiety ratings (Boles et al., 2022) which indicates the way food is promoted to us can influence our expectations and behaviour in food choices. Longitudinal data

analysis of the relationships between fast food consumption and food pricing has also outlined that there was a negative association between pricing and consumption (Gordon-Larsen, 2014). Exposure to advertising of foods such as unhealthy snacks can lead to increases in intake (Coates et al., 2019). Advertising of food on television may contribute to childhood obesity prevalence (Goris et al., 2010), and social media influencers commonly advertise unhealthy foods towards child audiences (Martínez-Pastor et al., 2021). The role of advertising in the intake of high-fat, salt and sugar foods has led to provision of advice for those creating content that is advertised to youth from the Advertising Standards Authority (Advertising Standards Authority | Committee of Advertising, n.d.). To summarise, whilst eating and physical activity are individual behaviours, the wider social and environmental context influences our actions. The context of behaviour contributes to food choices and intake and physical activity. Therefore, interventions to support weight-related behaviour change in obesity should also consider these factors.

Social norms can influence eating behaviours such as the amount and type of foods that are eaten or the sensation and enjoyment of different foods (Higgs, 2015). Norms are indicative of acceptable behaviours to engage in within a social context, and individuals will use their social network to build a reference of appropriate activities. Social norms can also influence physical activity. Survey methods have identified that perceptions about the physical activities of other people is highly correlated with an individual's activity (Priebe & Spink, 2011). Beliefs may impact on eating behaviours. For example, individuals may have concerns related to a topic such as food waste and therefore clear their plate and overeat to avoid this (Sheen et al., 2018). However, this may be beyond the amount of energy that is required for their energy expenditure, leading to an excess of calories. Similar beliefs may impact on individual behaviours with regards to portion size. Research has shown that portion sizes have been increasing for several decades (English et al., 2015) and particularly in the United States (Rozin et al., 2003). This is also shown in home recipe books. A Danish study found that calorie totals for consecutive editions of a home cookbook increased by 21% over a century (Eidner et al., 2013). When served a larger portion most individuals will increase their intake. This effect is believed to occur as individuals assume the portion served is of an appropriate size (Peter

Herman et al., 2015). As a result of the role that portion sizes can play in energy intake, several ideas such as providing more guidance on what constitutes a portion and reducing the classification of portion sizes in the food industry have been recommended (Marteau et al., 2015). Population-level interventions such as this may force changes without the need for focus on individual behavioural change. However, this requires support from industries such as fast-food chains to agree to reduce portion sizes (Young & Nestle, 2007). A 2016 review of such interventions to reduce portion size found there was limited support for significant change to portion size and that policies required voluntary agreement of food manufacturers to enact the reduction (Crino et al., 2016).

Hobbies and leisure activities may be more sedentary in the 21st century than ever before(Centers for Disease Control and Prevention (CDC), 2005), for example sitting to watch television, using the computer or video games (Panahi & Tremblay, 2018). Increased screen time is associated with overweight, less physical activity, and poorer dietary habits in adolescents (Christofaro et al., 2016). However, reviews of the literature have suggested that not all sedentary behaviours are associated with obesity development, as television appears to be a higher risk for children and adolescents than computers (Rey-López et al., 2008). The World Health Organisation consider physical inactivity to be a potentially leading contributor to death and disability globally (World Health Organisation, 2022).

1.6. Psychological approaches

Stress has been posited as causing obesity and other eating-related disorders due to the release of hormones that suppress appetite and eating of palatable foods to manage negative emotions (Sominsky & Spencer, 2014). Adverse life experiences are frequently reported as a risk factor for developing obesity and binge eating disorder (Palmisano et al., 2016). Psychological distress is associated with obesity and may be a mediating factor of emotional eating (Spinosa et al., 2019). Eating can be a response to negative affect such as depression, anger, and anxiety (Faith et al., 1997; Lowe & Fisher, 1983). This can lead to reductions in stress (Dallman et al., 2005). Emotional eating is a complex and difficult to measure behaviour involving eating in response to both positive and negative emotions (Bongers & Jansen, 2016). Some interventions intend to support weight loss through providing psychoeducation in coping and regulation skills (van Strien, 2018). Difficulties

with emotional regulation are associated with increased weight regain (Sainsbury et al., 2019). Therefore, treatment for obesity should also focus on development of skills that can support emotional regulation (van Strien, 2018).

Binge eating disorder is when the individual eats an amount of food which is more than they would usually and that leaves them feeling uncomfortably full. The current version of the Diagnostic and Statistical Manual (DSM; DSM-5, (American Psychiatric Association, 2013) reports that binge eating is characterised by eating, in a discrete period of time, an amount of food that is definitely larger than what most people would eat in a similar period of time under similar circumstances, and a lack of control over eating during the episode (e.g., a feeling that one cannot control what they are eating). The episodes of binge eating are associated with three or more of the following: eating much more rapidly than usual, eating until feeling uncomfortably full, eating large amounts of food when not feeling physically hungry, eating alone because of embarrassment over the amount of food they are eating, and feeling disgusted, depressed, or very guilty afterwards, marked distress regarding binge eating is present, the binge eating occurs, on average, at least weekly for three months, and it is not associated with the recurrent use of inappropriate compensatory behaviour such as in bulimia nervosa and does not occur exclusively during the course of bulimia nervosa or anorexia nervosa. The DSM-5 also denotes levels of severity which are categorised according to the frequency of binge eating episodes. One to three episodes of binge eating per week is reported as mild severity, four to seven episodes as moderate, eight to 13 episodes as severe, and 14 or more episodes per week as extreme (American Psychiatric Association, 2013).

The ICD-11 ((World Health Organisation, 2023) describes binge eating disorder as including frequent, recurrent episodes of binge eating (e.g., once a week or more over a period of three months). Binge eating is described as a discrete period of time (e.g., two hours) during which the individual experiences a loss of control over their eating behaviour, and eats notably more or differently to their usual eating behaviour. The individual may describe that they feel like they cannot stop or limit the type or quantity of foods eaten; having difficulty to stop eating once started, or giving up even trying to control their eating because they know they will end up overeating. Other required diagnostic

features are that the episodes are not accompanied regularly by inappropriate compensatory behaviours aimed at preventing weight gain nor secondary to another medical condition or disorder or effects of a medication they are receiving. Additionally, marked distress surrounding the pattern of binge eating or significant impacts to personal, family, social, educational, occupational or other important areas of functioning are required features for diagnosis (World Health Organisation, 2023).

'Food addiction' may be used as a descriptor of the eating behaviours present in obesity. Research suggests there are components of eating behaviour associated with neural pathways which may also show activation with other types of disorder and changes to the brain regions associated with eating for enjoyment (Liu et al., 2010). Arguments have been made for food addiction as a phenotype of obesity which is distinct and can be assessed using validated scales, such as the Yale Food Addiction Scale (Davis et al., 2011). However, the use of this term can increase perceptions of stigma towards individuals with obesity (Ruddock et al., 2019). Night-time eating is also reported to be a pattern of eating behaviour that is more frequently present in people living with obesity (de Zwaan et al., 2003). Individuals may experience a lack of appetite during waking hours and hyperphagia during the night. This can be disruptive for sleep and rest patterns, and it is positively associated with BMI (Colles et al., 2007) and binge eating disorder (Striegel-Moore et al., 2010).

1.6.1. Eating behaviour measurement

There are a range of different measurements used for the assessment of eating behaviours. For example, the Three Factor Eating Questionnaire (TFEQ, (Stunkard & Messick, 1985) and The Dutch Eating Behaviour Questionnaire (DEBQ; (van Strien et al., 1986). The DEBQ measures eating behaviour styles of emotional, external, and restrained eating that has good reliability and validity (Cebolla et al., 2014). The DEBQ includes 33 items that are completed using self-report methods. Factor analysis suggests a three-factor model and early studies found had very good internal consistency as assessed using Cronbach's alpha (van Strien et al., 1986). Examination of the psychometric properties of the scale in a sample of Spanish women showed that the subscales (*External Eating, Restraint,* and *Emotional Eating)* have very good internal consistency (Cronbach's alpha >.80). Cross-country validation studies of DEBQ measures have been conducted. An observer-

reported (parent-reported) version of the questionnaire has also provided support for a three-factor solution. The DEBQ-P was validated with Italian preadolescents and their parents, and reliability statistics indicated there was good internal consistency of the three subscales (Caccialanza et al., 2004). Disinhibition and sensations of hunger are thought to be important components within eating behaviour and obesity. Disinhibition is when eating is a response to stimuli such as emotional distress, particular social cues or contexts, and habitually driven. A review identified disinhibition as being associated with a greater BMI and consumption of foods which are considered less helpful and contributory to weight gain (Bryant et al., 2008). This suggests that interventions should address eating behaviour habits to support change in this domain. However, emotions related to eating may be conceptualised differently in different countries, samples, and languages (Cebolla et al., 2014).

Pedersen and colleagues (Pedersen et al., 2018) completed qualitative interviews with individuals who had maintained weight loss without regaining for less than 12 months and more than 12 months to understand if there was a difference between their self-regulatory strategies and beliefs surrounding self-efficacy. Findings suggested that individuals who are successful in maintaining weight loss for 12 months have integrated eating behaviour and physical activity changes into their habitual lives. Conversely, short-term weight loss participants considered the weight loss habits to be less automatic and more intentional. Other reviews of literature surrounding eating behaviours and weight loss have suggested that self-regulation with food intake is necessary and supporting people with self-regulation can aid with successful maintenance (Johnson et al., 2012).

Being able to maintain weight loss involves maintaining the strategies used to lose bodyweight initially. A number of factors have been associated with weight regain, including unrealistic weight goals, poor problem-solving skills, and low levels of self-efficacy in literature reviews (Byrne, 2002) and through qualitative research (Byrne et al., 2003). There are many different behaviours that can be targeted in psychological and behavioural support interventions for obesity (Carter & Jansen, 2012). As some research is suggesting that the biological impact of dieting can promote weight regain through effects on metabolic health (Dulloo & Montani, 2015) it is important to identify what mechanisms of interventions are effective and sustainable for individuals with obesity aiming to lose

weight. Interventions to address the role of psychological factors must consider the impact of other life experiences and contributing factors, such as the environmental context of the individual's bodyweight and experiences of socioeconomic status and stigma, in order to target the appropriate behaviours.

1.7. Weight stigma and bias

Individuals living with overweight and obesity are frequently exposed to weight discrimination (weight stigma) in many areas of life including employment, education, and recreational activities (Kristen, 2002; Puhl et al., 2008). This is associated with poorer outcomes such as depression and anxiety, low self-esteem, and lower physical activity levels (Puhl & King, 2013). This is due to the negative stereotypes and bias that some associate with obesity.

There is bias against individuals with higher bodyweight that is present across many forms of media. Weight bias is highly prevalent and there are very few legislative tools for preventing weight-related discrimination (Puhl et al., 2008). Experiences of this form of discrimination appears to increase likelihood of obesity by 2.5 times in those without obesity at baseline, as assessed by longitudinal studies using participants from the Health and Retirement Study (Sutin & Terracciano, 2013). Blaming individuals for developing obesity is bad for public health as it interferes with the delivery and efficacy of effective interventions and furthers disparities in healthcare (Puhl & Heuer, 2010). Stigma can be internalised by those living with obesity. Weight stigma is associated with measures of disordered eating, and with distress. It has been associated with increased calorie intake and decreases to self-report capability of eating control, in experimental studies using media articles with content about weight stigma (Major et al., 2014). The internalisation of weight bias is believed to mediate the relationship with disordered eating behaviours (O'Brien et al., 2016). Measures have been developed that demonstrate internalised weight-related stigma is a significant predictor of body image, self-esteem, and binge-eating behaviours (Durso & Latner, 2008). A cyclical model of exposure to weight stigma being positively associated with weight gain has been suggested (Tomiyama, 2014).

Healthcare may present challenges for those living with obesity due to prevalence of bias and stigma held by healthcare staff. These beliefs can influence the treatment received and perceptions held about the person living with obesity (Phelan et al., 2015) including perceptions about non-compliance with treatment and lower motivation in adults living with obesity (Puhl et al., 2014). Healthcare staff have reported that these attitudes are prevalent in their workplaces (Puhl et al., 2014). All patients should be treated with empathy and compassion, and there are learning opportunities for this within the context of the management of obesity (Fruh et al., 2018; Seymour et al., 2018) given that there may be unconscious weight-related biases held by those in the healthcare professions (Miller et al., 2013). Those living with obesity have reported that they experience stigma in all domains of life and it can lead to social isolation and reduced participation in daily living activities including healthcare access (Lewis et al., 2011). The World Obesity Federation have developed media reports and update an image bank for media and research to use to reduce weight stigma by providing non-stigmatising images of people with obesity (World Obesity Federation, 2018).

1.8. Overall summary of factors contributing to bodyweight

To summarise, the development and maintenance of obesity is a complex and multifactorial condition. From a genetic and evolutionary perspective, there may be genetic predispositions leaving some individuals at an increased likelihood of developing obesity, possibly due to the advantages of fat storage (Speakman, 2008). However, it is more likely that a larger contributor is that of the obesogenic environment. This the culmination of a lived environment that is focused on reduced opportunities for physical activity and increased ease of transport, and more sedentary lifestyles (Kirk et al., 2010). The ease of accessibility to highly palatable foods of low nutritional value can influence decision making in eating behaviours, both in terms of taste preferences and from a social perspective where it may be a more financially achievable and physically accessible than high nutritional value foods (Marteau et al., 2015). This can lead to calorie intakes in excess of the amount recommended and consequentially, weight gain. Further, the social and cultural context of modern living includes an inaccurate but commonly reported association between thinness and health, and increased bodyweight-related stigma through the media and professional attitudes in healthcare and employment

settings. Eating behaviours can also be affected by stress and other emotions. Experiences of stigma may be cyclically associated with increases to calorie intake (Tomiyama, 2014). The next section will discuss the current treatment interventions utilised for obesity management and the rationale for the current thesis.

1.9. Diagnosing and treating obesity

Obesity is diagnosed in clinical practice using several methods including assessment of Body Mass Index (BMI), waist circumference (WC) and body fat percentage as well as the identification of other clinical risk factors (NHLBI Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Obesity in Adults (US), 1998).

1.9.1. BMI

BMI (kg/m^2) is calculated as an individual's bodyweight in kilograms divided by their height in metres squared. It provides a description of bodyweight relative to height and it is significantly correlated with total body fat content. BMI scores are used to classify underweight, overweight, and obesity (see Table 1) and to inform the application of healthcare interventions. BMI cut-off points vary depending on ethnicity (Caleyachetty et al., 2021; Deurenberg et al., 1998). Within some populations, lower cut-off points are used. Cut-offs of 23.9 in South Asian populations, 26.6 in Arab populations, 26.9 in Chinese populations, and 28.1 in Black populations have been recommended for use (Caleyachetty et al., 2021).

Table 2. BMI cut-off points

Classification	**Cut-offs**
Underweight	<18.50 kg/m^2
Overweight	>25.00 kg/m^2
Obesity	>30.00 kg/m^2

However, BMI has been criticised. Firstly, in addition to objectively collected measures, it can use self-reported measurements of height and bodyweight, which may not be accurate. Secondly, it is

an *indirect* measure of body fat, which may not be appropriate considering there are more direct methods to understanding body composition. Thirdly, it has poor sensitivity to individual differences in body composition and may not be accurate for some age groups and populations (Rothman, 2008), which has led to widespread media coverage of incorrect obesity diagnoses. Regardless, BMI has an enduring utility and is frequently collected in healthcare interactions and research studies as a measure of effectiveness. It is a simple calculation and can be used for population-level monitoring as well risk profiling for comorbid conditions (Nuttall, 2015).

As BMI cannot differentiate between muscle or bone and body fat, alternative methods such as body fat percentage can be used (Burkhauser & Cawley, 2008) which is the percentage of fat in the total body mass. The relationship between BMI and body fat percentage is different between ethnic groups and therefore cut-off points need to be specific to the population (Deurenberg et al., 1998; Deurenberg & Yap, 1999). The World Health Organisation (WHO) has recommended that waist circumference can be used as an alternative as it is easier and more accurate than measuring bodyweight and height and indicates risk of excess central adiposity (Garnett et al., 2008). They also noted that BMI was an appropriate anthropometric measure for risk factors of chronic disease (World Health Organisation Nutrition and Food Safety, 2011).

There are other measures which can be used to assess obesity and body composition, such as dual energy x-ray absorptiometry (DEXA) and other radiographic imaging techniques (Adab et al., 2018). These techniques may be more appropriate to use as they provide a clearer understanding of the distribution of fat (i.e., visceral fat which is found around the internal organs). This is more useful for predicting health outcomes. However, these techniques are expensive and may be inaccessible within non-specific or non-research settings. Therefore, indirect measures of obesity are more frequently used.

1.10. Initial weight loss and weight loss maintenance

Interventions to manage obesity can be effective at supporting initial weight loss and therefore improving health outcomes. The National Institutes of Health recommend that within obesity, weight

loss of 10% can provide substantial health benefits (National Heart, Lung, and Blood Institute (NHLBI, 1998). However, initial weight lost may not be maintained beyond the short-term and individuals may experience weight regain, One review of existing research examined the association between initial weight loss and maintenance one year following completion of a behavioural intervention and identified no significant correlation between the variables, noting that around 54% of weight loss was typically maintained to the follow-up (Barte et al., 2010). Weight regain may be influenced by biological, environmental and behavioural factors (Greenway, 2015).

Examination of data provided by members of the National Weight Control Registry (Wing & Phelan, 2005) indicates that a number of behavioural changes are sustained by individuals who report maintenance of weight loss over a longer period (5 years), including changes to food intake and dietary patterns, self-monitoring, and physical activity. Reviews of the literature examining behavioural interventions suggest that interventions that address both diet and physical activity may result in greater weight loss, in comparison to those addressing single components (Wu et al., 2009). A systematic review examining the determinants of weight loss maintenance suggests that behavioural and cognitive factors that promote energy intake reduction, increase in energy expenditure (e.g., activity) and self-monitoring are predictive of weight loss maintenance (Varkevisser et al., 2018). Furthermore, maintenance of weight loss may be benefited by interventions involving brief personal contact (Svetkey, Stevens, & Brantley, 2008). Interventions that utilise pharmacological treatments in combination with behavioural changes may also support weight maintenance and health outcomes in the long term (Avenell et al., 2004).

1.11. Pharmacological interventions

Obesity can be managed with pharmacological interventions. These medicines work through methods such as preventing the body from absorbing fat or reducing appetite and hunger. Several medications are currently approved by the United States (US) Food and Drug Administration (FDA) including orlistat, phentermine-topiramate, naltrexone-bupropion, liraglutide, and semaglutide (Padwal & Majumdar, 2007). These medicines are prescribed when behavioural interventions that address diet and food intake and physical activity are not successful at producing the desired change

in bodyweight (Oh, 2019). Meta-analysis suggests medium to large effect sizes although research is ongoing to identify the most effective medication and mechanism of action (Haddock et al., 2002). However, the side effects experienced with anti-obesity medications (Ogden & Sidhu, 2006) may account for the high levels of attrition seen (Derosa & Maffioli, 2012). The addition of anti-obesity medicines to behavioural interventions may be more effective than treatment as usual conditions (Tak & Lee, 2021).

1.12. Surgical interventions

Bariatric surgery is also used to treat obesity. There are multiple types of bariatric surgery which are intended to make changes digestive system. This can include the body's ability to consume food, which in turn impacts on the individual's hunger and satiety cues. Meta-analysis has identified that bariatric surgery appears to be a more effective intervention for weight loss than other options that are less invasive, such as medication or behavioural interventions (Picot et al., 2009) and weight loss may be sustained for a longer period of time. There are several different types of bariatric surgery, including gastric bands, gastric bypass, sleeve gastrectomy, intra-gastric balloon, and biliopancreatic diversions. Gastric bands are one of the most frequently performed surgical interventions for obesity. However, retrospective reviews of patients who underwent the surgery found that 22% regained their weight or exceeded the original bodyweight. Therefore, it may not be an effective surgical intervention (Kowalewski et al., 2017). Gastric bypasses are also commonly performed. A Roux-en-Y gastric bypass is currently considered the gold standard in bariatric surgery (Miras & le Roux, 2018). Research from long-term follow-up reports that over 85% of patients lose and maintain their initial weight loss of 50% excess weight (Madura & DiBaise, 2012). Systematic review and meta-analysis of patients who have undergone bariatric surgery has found successful remission of comorbid conditions such as diabetes, high blood pressure, and sleep apnea (Buchwald et al., 2004). Therefore, this can be an effective approach to treating obesity. However, it is also associated with side effects such as nutritional deficiencies from the resulting reduced food intake (Tucker et al., 2007).

Although bariatric surgery results in physiological changes to biological functions of eating behaviour, outcomes are also impacted by adherence to post-operative behaviour changes such as

food intake, physical activity, and follow-up care (Spaniolas et al., 2016). Cohn and colleagues completed a systematic review of qualitative research investigating patient motivations and expectations in advance of bariatric surgery. Poorer outcomes of surgery are associated with a lack of support for the underlying psychological issues such as emotional distress. Patients awaiting surgery described important concepts before the surgery as including their relationships with eating behaviour and food, physical activity, and personal identity (Cohn et al., 2019). Other research reports that experiences of weight-based stigmatization and poorer outcomes of psychological and quality of life are common amongst those who are seeking bariatric surgery (Coulman et al., 2017; Friedman et al., 2008; Munoz et al., 2007). Some research has reported that the initial loss of weight can be difficult to maintain for patients due to the changes required in their behaviour, which can lead to issues with nutritional intake and weight regain (Rusch & Andris, 2007). A randomised controlled trial of psychological support pre- and post-bariatric surgery found that it had no effect on weight loss at 12-month follow-up. However, it is possible that the effects of support are clearer in the longer-term (Ogden et al., 2015). Weight loss over time also requires support for behaviour change. Comparison of behavioural and surgical obesity interventions reports similar levels of weight regain; however, participants undergoing surgery reported significantly less exercise and dietary restraint, higher consumption of fats, depression, and stress in comparison to the non-surgical group (Bond et al., 2009). The maintenance of this initial weight loss is challenging (Wing & Phelan, 2005). Changes to weight-related behaviours need to be maintained over a prolonged period to address food intake and reduce the likelihood of weight regain.

Therefore, psychological support for behaviour change is recommended (Greenberg et al., 2009). This should be integrated through all stages of the bariatric surgery process (Liebl et al., 2016). Other qualitative research with patients also suggests that this care should be integrated into specialist weight management services and would be appreciated by patients (Chan et al., 2020). Additionally, whilst surgical intervention may amend human appetite, some behaviours are influenced by earlier experience, thoughts, perceptions, and cognitions. Consequently, a form of wraparound support is necessary to ensure that an individual feels capable of maintaining their weight loss over

the longer term and that weight regain is not enabled by behaviours which may be associated with the development of obesity.

1.13. Behavioural interventions

Interventions that address behaviour change can be implemented at a population-level, or an individual level.

1.13.1. Population level

Interventions to support behaviour change may be delivered at a population or individual level. Population-level interventions for food intake choice can include techniques such as stating portion sizes or providing information on the number of calories in a food item (Kaur et al., 2019; Reynolds et al., 2021). These interventions provide information to aid with making food choices. Interventions can address environmental factors to influence food and eating behaviours, such as through introducing or removing food vending machines. Information about the impact or effect of food choices may be disseminated through public advertising and media. Economic interventions have also been implemented, such as the creation of higher tax rates for high-sugar foods (Sarlio-Lähteenkorva & Winkler, 2015). With regards to physical activity, changes to the environment, such as the introduction of street lighting and street gym activity for public use have been introduced to promote engagement with exercise. These intervention designs have mixed findings regarding acceptability by the public (Bos et al., 2015) as they can be perceived as intrusive.

1.13.2. Individual level

Individual level interventions intend to manage obesity through supporting changes to eating and physical activity behaviours for weight-related health outcomes. They are recommended within clinical guidelines for obesity care (National Institute for Health and Social Care Excellence, 2014; NHS, 2019). Group weight-management and lifestyle courses include psychoeducation and nutrition education components and offer social groups with others who are trying to reduce bodyweight (Ahern et al., 2011). The intention of providing this information and group setting to individuals

wanting to lose weight is to support them in making changes to their weight-related behaviours. A variety of different social contextual factors account for efficacy of behaviour change interventions, such as social support (Miller & Rose, 2010). Social support is thought to be associated with greater weight loss after bariatric surgery (Livhits et al., 2011).

1.14. Behaviour change interventions

It is important to understand what works in interventions to ensure they are delivered in the appropriate way and with the necessary content. To understand this, theories of behaviour change can be used. Applying health behaviour change theory is recommended as a key step in intervention design and evaluation according to the UK Medical Research Council's guidance (Campbell et al., 2000). There are over 80 theories which try to explain behaviour (Davis et al., 2015; Michie et al., 2014). Researchers have used theories of behaviour change to identify techniques that may be appropriate for use in different health behaviour domains, such as addiction, to identify which determinants could be targeted within interventions (Webb et al., 2010). To provide clearer information on what is involved within behavioural interventions, researchers have developed taxonomies of techniques that allow for the 'active ingredients' of interventions to be clearly stated and reported (Michie & Johnston, 2012). A commonly used taxonomy within health behaviour change intervention design is the Behaviour Change Taxonomy (BCTTv1; Michie et al., 2013). The BCTTv1 includes 93 techniques which are clustered around 16 groupings (see Table 3).

Table 3. List of BCT groupings from the BCTTv1

1. Goals and planning	
	1.1 Goal setting (behavior)
	1.2 Problem solving
	1.3 Goal setting (outcome)
	1.4 Action planning
	1.5 Review behaviour goal(s)
	1.6 Discrepancy between current behavior and goal
	1.7 Review outcome goal(s)

	1.8 Behavioral contract
	1.9 Commitment
2. Feedback and monitoring	
	2.1 Monitoring of behavior by others without feedback
	2.2 Feedback on behavior
	2.3 Self-monitoring of behavior
	2.4 Self-monitoring of outcome(s) of behavior
	2.5 Monitoring outcome(s) of behavior by others without feedback
	2.6 Biofeedback
	2.7 Feedback on outcome(s) of behavior
3. Social support	
	3.1 Social support (unspecified)
	3.2 Social support (practical)
	3.3 Social support (emotional)
4. Shaping knowledge	
	4.1 Instruction on how to perform a behavior
	4.2 Information about antecedents
	4.3 Re-attribution
	4.4 Behavioral experiments
5. Natural consequences	
	5.1 Information about health consequences
	5.2 Salience of consequences
	5.3 Information about social and environmental consequences
	5.4 Monitoring of emotional consequences
	5.5 Anticipated regret
	5.6 Information about emotional consequences
6. Comparison of behaviour	
	6.1 Demonstration of the behavior
	6.2 Social comparison
	6.3 Information about others' approval
7. Associations	
	7.1 Prompts/cues

	7.2 Cue signalling reward
	7.3 Reduce prompts/cues
	7.4 Remove access to the reward
	7.5 Remove aversive stimulus
	7.6 Satiation
	7.7 Exposure
	7.8 Associative learning
8. Repetition and substitution	
	8.1 Behavioral practice/ rehearsal
	8.2 Behavior substitution
	8.3 Habit formation
	8.4 Habit reversal
	8.5 Overcorrection
	8.6 Generalisation of a target behavior
	8.7 Graded tasks
9. Comparison of outcomes	
	9.1 Credible source
	9.2 Pros and cons
	9.3 Comparative imagining of future outcomes
10. Reward and threat	
	10.1 Material incentive (behavior)
	10.2 Material reward (behavior)
	10.3 Non-specific reward
	10.4 Social reward
	10.5 Social incentive
	10.6 Non-specific incentive
	10.7 Self-incentive
	10.8 Incentive (outcome)
	10.9 Self-reward
	10.10 Reward (outcome)
	10.11 Future punishment
11. Regulation	

	11.1 Pharmacological support
	11.2 Reduce negative emotions b
	11.3 Conserving mental resources
	11.4 Paradoxical instructions
12. Antecedents	
	12.1 Restructuring the physical environment
	12.2 Restructuring the social environment
	12.3 Avoidance/reducing exposure to cues for the behavior
	12.4 Distraction
	12.5 Adding objects to the environment
	12.6 Body changes
13. Identity	
	13.1 Identification of self as role model
	13.2 Framing/reframing
	13.3 Incompatible beliefs
	13.4 Valued self-identity
	13.5 Identity associated with changed behavior
14. Scheduled consequences	
	14.1 Behavior cost
	14.2 Punishment
	14.3 Remove reward
	14.4 Reward approximation
	14.5 Rewarding completion
	14.6 Situation-specific reward
	14.7 Reward incompatible behavior
	14.8 Reward alternative behavior
	14.9 Reduce reward frequency
	14.10 Remove punishment
15. Self-belief	
	15.1 Verbal persuasion about capability
	15.2 Mental rehearsal of successful performance
	15.3 Focus on past success

	15.4 Self-talk
16. Covert learning	
	16.1 Imaginary punishment
	16.2 Imaginary reward
	16.3 Vicarious consequences

Within obesity contexts, health services have recommended that techniques such as goal setting, advising the self-monitoring of behaviour (e.g., diaries or record keeping), reviewing progress of behavioural goals, creating action plans, and providing feedback on performance as potentially effective techniques within weight management (Public Health England, 2017).

1.15. COM-B

The determinants of behaviour are concepts that can be used to identify what is important for interventions to address. They can support research by informing what interventions should target to lead to effective change. The COM-B model (Michie et al., 2011) was developed following review of multiple frameworks of behaviour change theory and intervention development. This model argues that for behaviour to occur, individuals must feel they have the *capability*, *opportunity*, and *motivation* to change. Capability can be psychological and physical (e.g., the knowledge to engage in a physical activity). Opportunity is an external factor that enables the behaviour to take place (e.g., the space to complete the activity). Motivation is both habitual (e.g., the automatic process) and conscious (e.g., making a decision and plan to perform the activity). The COM-B model has been applied to the development of a diverse range of health behaviour intervention types such as supporting hearing aid use in adults (Barker et al., 2016), sexual health screening (McDonagh et al., 2018), and maternal weight management (Flannery et al., 2018).

1.16. Motivation in weight management

Motivation is a construct that refers to the drive to act or behave in a certain way. There are several theoretical approaches that consider motivation in relation to weight management. One theory which utilises motivation as a core component of behaviours is Self-Determination Theory (SDT;

Deci & Ryan, 2012). Within SDT, individuals must have the basic psychological needs of autonomy, relatedness and competency (at completing the behaviour) in order to achieve growth and feel intrinsically motivated (Deci & Ryan, 2012). Competence is the feeling of mastery or capability to complete a behaviour or effect outcomes (Markland et al., 2005). Relatedness refers to the sense of connection and acceptance from others and can be met through ensuring warmth and genuineness within interactions. Ryan & Deci (2008) reported that when individuals feel this need is met, their sense of satisfaction for autonomy and competence needs.

SDT was developed from studies of motivation for behaviours and reward which identified financial reward was not intrinsically motivating. Intrinsic motivation refers to motivation that comes from inherent enjoyment or desire for the behaviour itself. Comparatively, motivation can also be extrinsic, which comprises a behaviour being performed for reasons other than inherent enjoyment and at different levels of internalisation. For example, an individual may engage in a behaviour in order to meet a reward or avoid punishment (external regulation); to seek approval from others (introjection), to work towards self-endorsed goals (associated with an internalised perception of causality) (Deci & Ryan, 2020). Individuals may also experience amotivation, which is a lack of perceived competence, value or relevance of the behaviour to their identity.

Autonomy is the concept of autonomous self-regulation. This can involve both intrinsic motivation (motivation for the inherent satisfaction or enjoyment) and well-internalized extrinsic motivation (Deci & Ryan, 2012). Within the theory of SDT, autonomy does not correspond to independence, as individuals can choose to be dependent or receive support from others (Deci & Ryan, 2012); thus, SDT indicates that support with behaviour change can be provided in an autonomy-supportive way, if the relationship is respectful of the individual looking to make the change (Deci & Ryan, 2012). One meta-analysis of over 180 datasets (Ng et al., 2012) identified that support for patient autonomy from practitioners and the patient experience of their psychological needs being satisfied, were associated with beneficial health outcomes, increased patient autonomy, and greater needs satisfaction. Furthermore, psychological needs and autonomy were moderate predictors of protective health behaviours such as smoking abstinence, physical activity and

adherence to treatments. Therefore, promoting autonomy and supporting intrinsic motivation (or integrated extrinsic motivation) may be an important component of interventions for health behaviour change.

Theories may also consider the intention to act as a key predictor of the behaviour taking place (Theory of Planned Behaviour (TPB; Ajzen, 1991)). The intention is informed through personal attitude to the behaviour, beliefs around what other people view the behaviour (subjective norm), and perceptions of control over the behaviour. Within health behaviour change, the theory appeared to explain some variance within behavioural intentions and action, although this varied between different types of behaviour (Godin & Kok, 1996). For example, within intentions to take part in physical activity within adolescents with overweight and obesity, structural equation modelling indicated that around 62% of variance in the intention was accounted for by attitude, perceived behavioural control, and subjective norms, whereas 44% of the variance in behaviour was explained by perceived control and intentions to engage in the behaviour. Perceived behavioural control was more strongly associated with physical activity levels than with intention to take part in the activity, demonstrating that other psychological factors are more strongly predictive of behaviour than intentions (Plotnikoff et al., 2013).

Other models consider the role of fear or threat within health behaviour change. Protection Motivation Theory (PMT; Rogers & Prentice-Dunn, 1997) was developed in the 1970s and suggests that individuals will act if they believe there is a threat. Within the context of health behaviour, this could be the likelihood of developing a health condition. If the threat was considered to be severe, likely to happen, and could be avoided through engaging in another behaviour, individuals may act to avoid the threat. However, Rogers and colleagues theorised that the motivation or desire to engage in the protective behaviour was impacted by a number of factors, for example, reduced self-efficacy or confidence in being able to complete the behaviour, or if there are benefits from continuing with the behaviour that causes the threat. To explore the theory of protective motivation, researchers have examined the intentions or likelihood of the intended behaviour taking place. One meta-analysis identified that across 65 research studies, increases in threat severity, vulnerability to the threat, and

self-efficacy were moderately strong predictors of engaging in and intentions to engage in the protective behaviour (Floyd, Prentice-Dunn & Rogers, 2000).

Similarly, the Health Belief Model (Rosenstock, 1974) includes constructs such as individual beliefs (of susceptibility to the threat, and potential severity), demographic characteristics, and cues to act (e.g., reviewing materials or educational resources that warn about the risk). The decision to make the behaviour change is informed by these constructs and the potential benefits or barriers to the behaviour. One review identified that individual beliefs and perceived benefits were the best predictors of dieting behaviour (Daddario, 2007). An intervention for individuals with overweight/obesity based on the Health Belief Model improved participants' self-efficacy, perceived susceptibility and severity, barriers and benefits, and resulted in improved liver enzyme test results within the intervention group but not the control group (Nourian et al., 2020). However, other research has highlighted that although individuals may intend to change their health behaviour, this may not always be mirrored in practice. Within health behaviours that are associated with weight, such as physical activity, research has examined the gap between intention and the ability to initiate and maintain a new physical activity regime. The gap between intention and action was mediated by a number of factors that could be addressed within interventions. The initial intention or motivational phase and then implementing the behaviour change (volitional stage) required self-efficacy beliefs in ability to complete the behaviour, strategies for self-regulation, and planning for how the behaviour would occur (Sniehotta et al., 2004).

Research has examined the role of autonomous self-regulation and motivation within behaviour change interventions. Williams and colleagues (1996) examined motivation amongst participants with obesity in a weight-loss programme over two years. The findings indicated that participants with more autonomous motivation had improved adherence to the programme, greater weight loss and maintenance of weight loss over the follow up period. Other research has also reported that controlled motivation at baseline is negatively correlated with weight loss at 4-month follow-up (Webber et al., 2010). Gorin et al (2008) examined autonomous and controlled regulations over a 6-month period in individuals with obesity. The analysis found that higher levels of controlled regulation at baseline

were associated with a reduced amount of weight loss, whereas increases to autonomous regulation were predicted a greater weight loss at 6-months. Within reviews of weight management studies, autonomous motivation is a predictor of successful self-regulation in eating and weight management behaviours, weight loss, and maintenance of weight loss (Teixeira et al., 2006). A meta-analysis of 21 studies examining long-term weight maintenance identified that higher levels of self-efficacy, autonomous motivation, self-regulation and monitoring skills were positive mediators for physical activity within this context (Teixiera et al., 2015). Webber and colleagues (2010b) identified that within an online behavioural weight loss intervention, autonomous motivation was a predictor of adherence to self-monitoring and of weight loss at four months. Autonomous motivation did not change significantly over the course of the study for the total sample, although participants who did not experience 5% weight loss had significantly lower autonomous motivation than those who reached this amount of weight loss. The authors suggest that building motivation early and maintaining this is an important focus for weight loss interventions.

Other research has examined how motivation for a specific context such as physical activity may transfer to other situations, for example, weight management studies that address a number of related behaviours such as eating and physical activity. Mata and colleagues (Mata et al., 2009) assessed physical activity behaviours, general and specific self-determination, and self-regulation in participants with overweight or obesity taking part in a 12-month physical activity intervention. Increased general self-determination, treatment and exercise motivation were predictors of improvements in eating self-regulation during weight control, showing that the intervention effects 'spilled over' into another context. Autonomous motivation appears to predict outcomes within weight management interventions (Teixeira et al., 2012). One study identified that at one, two and three years follow up, both physical activity and weight outcomes were predicted by autonomous exercise motivation, which demonstrates the possible trans-contextual nature of intrinsic motivation (Silva et al., 2008). Thus, interventions that are able to build autonomous self-regulation and intrinsic motivation may be more effective at supporting weight loss and weight loss maintenance.

1.17. Motivational interviewing (MI)

Motivational interviewing is an approach to communication that involves both relational skills known as the 'spirit' of MI to ensure an empathic, collaborative, and autonomy-promoting approach and technical or content-based skills (Miller & Rollnick, 2013). Conversations where one individual is using MI skills are intended to build motivation in the direction of a behavioural goal through questions and statements that identify 'change talk' support of the change (Rollnick & Miller, 1995). MI is based on intuitive clinical experience and has similarities with Rogers' client-centred therapeutic approach (Csillik, 2013). MI is not intended to coerce or mislead patients by convincing them about what they need to do, but to evoke their own reasons for change and ideas for action (Miller & Rose, 2009). It is recommended to use MI and listening skills in medical practice to guide patients towards change (Rollnick et al., 2010). In various health behaviour contexts, such as substance and alcohol use, research has supported the application of MI as an effective intervention (Lundahl et al., 2010). Typically, MI follows four key processes of *engaging* with an individual, *evoking* their reasons for the change (rather than advising or instructing of the benefits of change), *focusing* on an area or topic to target the behaviour change, and *planning* the steps to take towards change that are appropriate for their life and context (Miller & Rollnick, 2013). To do this, the practitioner will use skills such as open-ended questions, affirming statements recognising their effort and strengths, reflections to interpret their experience, and summary statements (Miller & Rollnick, 2013).

1.17.1. Theoretical mechanisms

Several hypotheses of MI mechanisms have been discussed. Three of these are known as the technical hypothesis, the relational hypothesis, and the conflict resolution hypothesis (Magill & Hallgren, 2019; Romano & Peters, 2016). The technical hypothesis suggests that the causal mechanisms of MI are based on the skills of the practitioner. Systematic review identified support for this hypothesis as MI-consistent skills were correlated with more change talk (Magill et al., 2014). Inconsistent MI skills were associated with less change talk and more change in favour of maintaining

the status quo ('sustain talk'). The relational hypothesis suggests that the interpersonal components of MI (e.g., the spirit of the approach, collaboration, and expressions of empathy) drive effectiveness of the approach (Miller & Rose, 2009). However, there is limited support for this hypothesis as meta-analysis has found that relational skills are not predictive of behaviour change (Magill et al., 2018). The conflict resolution hypothesis argues that it is the resolution of ambivalent feelings surrounding the behaviour change of interest that leads to behaviour change (Magill & Hallgren, 2019). Some trials of MI have found no predictive utility of therapist empathy and MI spirit for alcohol use outcomes which suggests no support for the relational hypothesis (Magill & Hallgren, 2019). Other research using trial data found that both relational and technical components of MI need to be implemented to see effective outcomes (Villarosa-Hurlocker et al., 2019).

1.18. Motivational Interviewing and weight management interventions

Theoretically, research has indicated that supporting patient autonomy is associated positively with beneficial health outcomes, increased patient autonomy and greater needs satisfaction (Ng et al., 2012). A core component of an MI approach is to promote the autonomy of the patient and to ensure a non-judgemental attitude. MI intends engage and build rapport, to identify and evoke individual reasons for the change, focus on an area of interest, and plan the steps towards making the change (Miller & Rollnick, 2013). These components appear in line with the theoretically important motivational factors for weight-related behaviour change. An MI approach also involves action planning, which is one valuable technique for resolving the gap between intentions and behaviour (Sniehotta et al., 2004). MI encourages the consideration of discussions that are in the direction of change (change talk) and appears to support development of autonomous self-regulation and perceptions of capability (Silva et al., 2010). Through use of an MI approach, practitioners try to identify and elicit the individual's reasons and plans for change, as opposed to their own prescriptive suggestions or instruction, or through fear-based approaches. MI may be particularly important for weight management as it is an approach that focuses on amplifying the individual's intrinsic motivations and desires for the change. This allows for actions and goals to be developed that are

implementable to the individual's life, e.g., things that they enjoy, which may support maintaining motivation in weight loss maintenance (Ford & Herman, 1995).

One study examined psychological variables of self-regulation, self-determination, and motivation for a behaviour change and treatment adherence in a physical activity intervention for adults living with obesity. The findings suggested that increased general self-determination and intrinsic motivation for physical activity also predicted successful eating behaviour self-regulation. The authors noted that addressing one behavioural domain may result in transference of motivation to other contexts. However, the research findings regarding interventions that address multiple behavioural domains is mixed. The authors theorised that interventions which do not utilise an autonomy-promoting approach may not successfully increase self-regulation and intrinsic motivation for the behaviour (Mata et al., 2009).

Focusing on bodyweight as the key measure of intervention effectiveness may result in difficulty with maintaining adherence to the intervention when the goal is not reached quicky, and neglects important process benefits such as enjoyment (Teixeira et al., 2012). Therefore, it is building intrinsic motivation for the behaviour itself, and not solely the weight-related outcomes. MI intends to resolve ambivalence and cultivate intrinsic motivation that matters to the individual (Miller & Rollnick, 2013) and therefore may be an appropriate intervention to support behaviour change in this context. One study compared MI to a skill-based intervention for weight loss. The researchers hypothesized that as MI intends to build meaningful personal motivation for the behaviour change, it would be more effective at supporting long-term maintenance than the comparator condition. The results demonstrated comparable weight loss at 18 months between the interventions, but this was significantly greater than the weigt loss reported within the control group. The MI group reported significantly greater autonomous self-regulation, which indicates that the intervention was effective at supporting the targeted changes (West et al., 2011). Interventions using an MI approach may improve the amount of initial weight lost above and beyond that of treatment as usual or advice provided by practitioners not using an MI approach (Armstrong et al., 2011), and other research has found that an

intensive motivational interviewing intervention may support long-term (over 12 months) maintenance of weight loss (Simpson et al., 2015).

1.19. Rationale and overview

However, research has also identified many differences in the delivery of MI and in the consistency of MI skill use with the ethos of the approach. Therefore, researchers have developed measures of fidelity assessment to confirm that the integrity of the treatment was delivered in a rigorous way (Moyers et al., 2016). This is particularly important given that adherence to specific techniques is associated with larger effects on behavioural outcomes (O'Halloran et al., 2014). Research has reported on a paucity of replicable, detailed methods descriptions of MI, which means the active ingredients have not been confirmed (Hardcastle et al., 2015). This prevents reproduction of effective interventions which can be widely applied. Research is needed to establish what the underlying mechanisms of MI are as delivered to support individuals with behaviour change. This will develop a solid base of evidence for the use of MI within a health-related context. The relational techniques used within MI may provide some explanation for its mechanisms (Hardcastle et al., 2017). The approach to establishing the active components of MI involved mapping the intervention onto a widely used taxonomy of behaviour change techniques, the BCTTv1 (Michie et al., 2013). Defining MI using BCTs from this taxonomy furthered understanding of how MI effectively causes behaviour change and can assist in the creation of future MI-based interventions.

To investigate this gap in the literature, this thesis reports on a set of linked research studies. The studies were designed to determine what previous research has identified regarding the effectiveness of MI, the perceptions and understanding of healthcare professionals who use MI within behaviour change settings, and to test the intervention and clarify what techniques were used within the context of weight-related behaviour change.

The first study reported a systematic literature review and meta-analysis to identify previous literature and provided statistical summary of effectiveness findings. The methods sections of

identified studies were coded to report the BCTs and MI techniques that are present and inform understanding of what occurs within studies using an MI intervention.

The second study used qualitative research methods to explore what healthcare professionals think is effective (or non-effective) for supporting behaviour change in their patient groups, which may differ to manualised research trial interventions. This provided insight on what professionals who work closely with patients and apply their skills outside of research contexts think about effective behaviour change support.

The third study tested MI for a specific behaviour domain of physical activity. Whilst the sessions were individually tailored and designed to support each participant with identifying, planning, and achieving their goals, pre-post descriptive scores were collected to assess effectiveness of the intervention. Additionally, to inform understanding of what kind of techniques were used, the sessions were audio-recorded to provide opportunity for a nested coding component. Through these methods, the BCTs used are clearly identifiable.

Finally, the fourth study compared an MI intervention to a comparator condition. This was within the context of adults with obesity who are interested in making any kind of change to their weight-related behaviour. This ensured that the intervention was in line with an autonomy-promoting approach and reviewed if the MI sessions were effective in supporting individuals with their behaviour change goals. By assessing feasibility outcomes, the study is informative for future MI trials. The audio of sessions was recorded to permit the coding of session content for MI techniques and BCTs. The next section provides the specific aims of each study completed.

1.20. Study aims

The aims of each discrete study are reported below:

1. Systematic review and meta-analysis
    a. To investigate the effectiveness of MI for adiposity outcomes in populations with obesity aiming to lose bodyweight.
    b. To evaluate the effectiveness of MI using meta-analytic methods.

c. To report the presence of BCT and MI-specific techniques.
d. To report the theoretical underpinnings described in MI research to inform understanding of how it is utilised.

2. Qualitative study
   a. To understand what practicing health professionals who have received training in MI understood it to involve when utilised in their professional role, in terms of the a) skills, b) delivery format, and c) underlying mechanisms of effectiveness.
   b. To understand how MI was perceived by practicing health professionals to support health-related behaviour change in their patients.
3. Single-group intervention study
   a. To investigate if MI was an effective intervention to improve participant's behavioural determinants (capability, opportunity, and motivation) of engaging in a specific health-related behaviour change (increasing physical activity).
   b. To identify which specific techniques from the BTTv1 and MI-specific content-based and relational techniques as defined by Hardcastle and colleagues (2017) were present in effective MI interventions where participants increased their physical activity.
4. Randomised controlled feasibility trial
   a. To investigate the feasibility of recruitment processes, intervention delivery, and retention of participants to a MI research trial for weight-related behaviour change in the context of obesity.
   b. To identify any required changes to be made in preparation for future MI trials.
   c. To examine if MI was likely to be an effective individual intervention for weight-related behaviour change in an adult sample with obesity, in comparison to the provision of information only (comparator).
   d. To identify the relational and technical factors that were present in successful individual-level MI interventions within the sample.

Chapter 2. General Methods

This thesis used a multi-methods approach. This chapter provides a list of the methods implemented for data collection and analysis and provides rationale for their use.

1. Questionnaire measures

A core outcome set for behavioural weight management interventions has been recommended for use by Mackenzie and colleagues (Mackenzie et al., 2020). Outcomes were identified through systematic review, and people with lived experience of obesity and adult weight management services contributed to a Delphi process to identify which outcomes should be measured and reported. The core outcome set includes process-based items (age; gender; ethnicity; deprivation category; physical disability; learning disability; mental health diagnoses; repeat referrals; attendance; completion; reason for drop-out) and core outcomes (body mass index (BMI); weight; diabetes status; quality of life (QOL) score; learning disability QOL score; adverse events; participant satisfaction; and cost effectiveness. To ensure the core outcome data was collected in the intervention study (Chapter 7), questionnaires included the recommended core outcomes apart from ethnicity data, deprivation data, and cost effectiveness. These data were not collected as the study was designed as an initial assessment of feasibility that could provide data to establish a future pilot study. However, this is a limitation of the study design as it is important to collect data on ethnicity and deprivation in order to inform understanding of equitableness of the intervention. Deprivation and ethnicity were not measured within the studies. This is a limitation of the research as it is important to assess these variables to inform understanding of the accessibility and appropriateness of interventions for the target populations. Additionally, this is recommended within the core outcome set for obesity (Mackenzie et al., 2020) and should be addressed in a future trial.

1.1. IPAQ-SF (Craig et al., 2003)

The International Physical Activity Questionnaire (IPAQ) short-form (IPAQ-SF) is a widely used questionnaire that assesses the intensity and frequency of vigorous, moderate, walking, and sedentary behaviours. It includes 9 items and participants provide the number of days in the last 7-day period

and the duration of time spent completing each activity. A systematic review has identified that the IPAQ has unacceptable correlation with objective measures of physical activity behaviour (Ahmad et al., 2018; Lee et al., 2011). However, the recall period is acceptable and completable for participants (Lee et al., 2011). Additionally, few questionnaires investigating physical activity have acceptable criterion validity. Over-reporting of physical activity behaviour has been frequently identified in self-report methods of data collection (Brown et al., 2004). The IPAQ-SF was used in Chapters 5 and 7.

1.2. WHO-5 (World Health Organisation Regional Office for Europe, 1998)

The WHO-5 is a 5-item index of wellbeing. Items relate to the respondent's experiences over the prior two weeks. Statements are scored on a 6-item Likert scale from "All of the time" (5) to "At no time" (0). A raw score is calculated by totalling the five answers, with 25 representing best-possible quality of life. Cross-country validation studies have indicated that the measure is psychometrically sound (Sischka et al., 2020) although there is a paucity of evidence for its content validity. The WHO-5 was used in Chapter 7.

1.3. AEBS/AEBS appetite drive subscale (Ruddock et al., 2017)

The appetite drive subscale of the Addiction-like Eating Behaviour Questionnaire (AEBS; (Ruddock et al., 2017)) was used. This subscale includes 9 items such as, *"I continue to eat without feeling full,"* scored from 1 (*never* or *strongly disagree*) to 5 (*always* or *strongly agree*) with a maximum possible score of 45. Higher scores are indicative of more addictive-like eating behaviours. Five items (items 6, 11, 12, 13, and 14) are reverse scored. The AEBS shows good internal reliability and correlates positively with BMI, and is a better predictor of variance in BMI than the Yale Food Addiction Scale (Gearhardt et al., 2009) or the Binge Eating Scale (Timmerman, 1999, Ruddock et al., 2017). The AEBS was used in Chapter 7.

1.4. Fruit and vegetable intake

Fruit and vegetable intake was assessed in Chapters 5 and 7 using a brief item requesting participants to provide 1) the number of portions of fruits and 2) the number of portions of vegetables consumed on a typical day over the preceding two weeks.

1.5. Behavioural determinants (including questionnaire approach)

Behavioural determinants were assessed in the reported studies using several approaches:

1.5.1. Non-validated measure of behavioural determinants

In Chapter 5 (interventional study 1), a pragmatic approach was taken to developing a brief measure of capabilities, opportunities, and motivations. This included a 6-item scale asking participants to rate their agreement with each statement from 1 (*not at all*) to 7 (*totally agree*), for example *"Other people are supportive of me engaging in physical activity,"* which represented the social opportunity behavioural determinant.

1.5.2. Brief measure of COM-B (Keyworth et al., 2020)

In Chapter 7 (interventional study 2) a brief, validated measure of behavioural determinants was used. Information about participants' perceptions of behavioural determinants of their intended change including the capability, opportunity, and motivation to engage with it was collected using a brief validated and reliable measure (Keyworth et al., 2020). 6 items such as, '*I have the physical opportunity to change my behaviour,'* were scored by participants on a scale ranging from *Strongly Disagree (=0)* to *Strongly Agree (=10).*

1.5.3. Brief pragmatic measure of self-reported goal progress and comparison to alternative measurement tools

Participants were interested in many different behaviour changes (e.g., dietary intake, physical activity, access to other support and healthcare resources) during the intervention reported in Chapter 7. Alternative approaches were considered as measurements of goal progress, including Goal

Attainment Scaling (GAS; Spence, 2007, Turner-Stokes, 2009). However, a key component of GAS is to determine the criteria for success in advance. As the interests of participants may become more refined during the intervention period this was not considered to be an appropriate tool, as participants may change their goal interests.

Therefore, a simple visual analogue scale (VAS) was developed with anchors at -100 a visual analogue slider scale (VAS) from -100 to +100, with the end of the scale representing, '*I have done a lot less than what I wanted to do,'* and '*I have done a lot more than what I wanted to do'*. A score of 0, positioned in the centre of the line, was annotated with the text, '*I have achieved exactly what I wanted to'.* An unvalidated measure of behaviour change rating was used as it provides an indication of how successful participants considered their behaviour change actions to be and could be completed quickly thus reducing the burden of survey completion. Participants were asked to provide rationale for their answer in a free-text box for their response.

1.6. Content of behavioural interventions

1.6.1. Content-based coding analysis

To identify the techniques used within MI, content-based coding analyses were nested within the systematic review and interventional studies in Chapters 3, 5, and 7. The Behaviour Change Technique Taxonomy version 1(BCTTv1; Michie et al., 2013) was used. The BCTTv1 was developed through the Delphi method and intends to provide a comprehensive set of techniques present within behaviour change interventions. The rationale for developing a comprehensive list of the smallest components of behaviour change methods is to support the development of effective interventions that can be replicated as the content is clearly understood and reported.

Several lists of techniques for behaviour change have been developed, including the CALO-RE list of techniques (Michie, Ashford, et al., 2011) which is specific to supporting people with physical activity and healthy eating behaviour changes, and techniques for smoking cessation (Michie, Hyder, et al., 2011). Assessments of how competently practitioners deliver behaviour change interventions have also been developed, such as the Behaviour Change Counseling Index (BECCI

(Lane et al., 2005), and behaviour change *methods* have been mapped to interventions and determinants (Kok et al., 2016) with the intention of furthering understanding about what is effective, in what circumstances, using which intervention components.

The BCTTv1 has been utilised within multiple health behaviour domains in comparison to the CALO-RE which is specifically focused on weight-related/physical activity/eating behaviour change. The BCTTv1 provides a greater number of techniques available for use and earlier work allows comparison to existing taxonomies including the MI-specific list of techniques discussed below.

1.6.2. Techniques specific to MI

However, the BCTTv1 does not identify relational techniques, nor techniques which are more specific towards an MI approach (Hagger & Hardcastle, 2014). Consequently, other researchers have developed an MI-specific list of techniques (Hardcastle et al., 2017). This list identifies the techniques present according to stage of MI (*engage; focus; evoke, plan*). This approach to coding also reports the overlap of techniques with the BCTTv1(Gagnon et al., 2018), resulting in a specific, targeted, and clear summary of the techniques present within MI sessions as delivered in practice. An MI-list of 38 MI-specific techniques including those focused on the content of behaviour change discussions and the relational rapport building have been developed by Hardcastle and colleagues (Hardcastle et al., 2017). This list was used to identify MI-specific techniques in Chapters 3, 5, and 7.

1.6.3. Considerations for content-based coding analyses

There were several important considerations for the use of content-based coding analysis methods. The BCTTv1 provides a training course (*https://www.bct-taxonomy.com/)* and practice materials for coder use. All coders involved in the analyses completed the coder training, met to discuss the taxonomy, and completed calibration exercises with pilot data and example transcripts or audio recordings. However, as a recently developed novel list of techniques there was no comparable training course for the MI-specific list of techniques. Therefore, the PhD researcher (HM) planned coder training, using examples of real-life MI recordings delivered by the original developers of MI regarding alcohol and drug use topics.

Computer-assisted qualitative data analysis software (CADQAS) was used to complete the analysis (NVivo; (QSR International Pty Ltd., n.d.)) using the audio or transcript coding function of the software. Each code was discussed in turn between the coders to begin the calibration process. A rule book including an example of the code and any additional notes or discussion points was shared with the coding/supervisory team including HM, supervisors and a peer PhD student in the department who had experience of using coding taxonomies.

Coding for BCTs and MI-specific techniques was then compared between the coders and inter-rater reliability statistics (kappa, percentage agreement, and prevalence- and bias-adjusted kappa statistics; (Byrt et al., 1993) (Gisev et al., 2013) were calculated following the initial calibration exercises and after the completion of second coding of audio and transcript data. Where discrepancies were identified, these were resolved through discussion and the inclusion of a third coder if required.

1.7. Treatment fidelity

Treatment fidelity refers to the reliability of intervention delivery in accordance with the original protocols and intended approach. In designing effectiveness studies, this can include reporting of the training that interventionists completed, how fidelity was monitored or supported during the intervention delivery period, how fidelity was assessed and how this was interpreted considering the results (Moncher & Prinz, 1991).

1.8. MITI (MI Treatment Integrity tool)

In MI, there are multiple approaches to assessing treatment fidelity which have been identified through systematic reviews of the available literature. For example, studies may use the BECCI to identify delivery of behaviour change interventions. Specific tools have been developed for use within MI to examine the interpersonal methods used in the delivery of behaviour change interventions (Martins & McNeil, 2009), such as the MI Skills Code (Miller et al., 2003) and MICA (Jackson et al., 2015). One such tool is the MI Treatment Integrity tool (MITI; Moyers et al., 2016). The MITI was selected as it has been used in research as a tool for studying the implementation of MI spirit. Other tools are more focused on use in training, coaching and development of MI skills (e.g., MICA) or

require more time to use (e.g., MISC; Jonge et al., 2005). The MITI was used in Chapter 5 and Chapter 7. For Chapter 7, MITI assessments of a random selection of data were completed by Health Psychologists external to the supervisory research team, who had completed Health Psychology Doctorate-level and MI training, as well as having in-practice, current experience of MI skills.

2. Qualitative analysis

Qualitative analysis was used to address the research objectives of identification of practitioner experiences and understanding of MI (chapter 4). Data analysis was completed with NVivo 12 (QSR International Pty Ltd).

2.1. Interview/topic guide development

The topic guide was developed by the PhD researcher and supervisory team (VF and LG). The supervisory team included research psychologists with experience of health-related research and qualitative research methods. The interview topic guide was developed based on findings from the systematic review which identified that reporting of the content of MI interventions was poor. Two topic guides were developed; one for individuals who used MI skills, and one for those who did not use MI (and used alternative behaviour change approaches). The topic guide for the group of MI users included the following key sections: experiences of training and learning about MI, experiences of using MI in practice, and beliefs and understanding of MI. The guide was adapted for the non-MI user sample to prompt views and experiences of MI and other communication approaches for behaviour change, and to provide understanding of communication approaches that may overlap with an MI-consistent approach. The interview topic guides were piloted with PhD students who had experience of receiving MI training and working in healthcare settings that included use of individual and group-based behaviour change interventions. The guides were reviewed and refined during the interviewing process to support the flow of the interviews and participant understanding.

2.2. Researcher positioning and reflexivity

The interviews were conducted by the PhD researcher. The PhD researcher's topic was focused on the area of MI within weight management in obesity contexts following an integrated MPsycholSci in Health and Clinical Psychology. The position and previous experience of the PhD researcher was reported to participants during recruitment and at the start of all interviews.

An important consideration for qualitative research is reflexivity, which is the contextual situation and position of the researcher (Dodgson, 2019). As a Psychology PhD researcher I was aware that when completing the qualitative and intervention studies in Chapters 4, 5, and 7, I needed to remain neutral and try to avoid imposing my own perspective or opinions onto the research. This was particularly important given the ethos of MI as an autonomy-promoting intervention. During the interview studies that were conducted with clinicians, my role was to learn more from their experiences as clinicians. To ensure that I was able to collect information from clinicians who may or may not be within a similar field or area (health psychology) to myself, I made sure to ask clarifying questions from all participants. Conversely, within the intervention studies that took place with research participants who were recruited from the university and wider general public, my role could be viewed as the interventionist with expert knowledge or instruction. The promotion of autonomy, and setting the agenda with participants, was one way of trying to ensure that the topics explored were useful and important to the participant. To continue developing my MI skills and consistency of promoting autonomy during the sessions, I completed regular supervision with my PhD supervisory team (Dr Anna Chisholm) and reflected on the contents of the sessions. This was an important component of my learning and skill development and helped me to identify areas where I could develop my MI skills further by noting any techniques or conversation topics that felt difficult at the time of the session.

The interviews were transcribed by myself (the PhD researcher) to support understanding of the data and to reduce the need for sharing data with others outside of the supervisory research team. My background and role as a researcher may have also impacted on the approach to analysis and interpretation of data as an individual without experience of living with obesity (Berger, 2015). When

research is conducted by an informed outsider, bias may be introduced into the analysis and interpretation of data. Methods were used to attempt to minimise this risk. Two transcripts were coded by two supervisors (AC and VF) of the supervisory team to review coding and discuss the initial themes developed. Although the approach used was thematic analysis, it is likely that my previous knowledge of health psychology and behaviour change theory influenced my interpretation of the data.

2.3. Semi-structured interview guide

A semi-structured interview guide was utilised in Chapter 4. This allowed for flexibility in the direction of conversations to ensure that the information pertained was relevant. It ensured that participants were not queried regarding topics that had already been spontaneously discussed and meant that participant comments could be further probed if relevant to the research questions. All participants were asked if they had any additional information to share at the end of the interview that had not been discussed already.

2.3.1. Thematic analysis (Braun & Clarke, 2006, Clarke & Braun, 2013)

The qualitative analysis approach selected was thematic analysis (Clarke & Braun, 2013). Thematic analysis is a reflexive, inductive approach that includes several key steps: line-by-line coding, examination of codes for similarities and differences, the development of coding groups or early themes, specification of key themes, and the generation of theme definitions. Thematic analysis is a recursive analysis process and where required earlier data is reviewed again and new line-by-line codes and themes added or refined if needed. This helped to ensure that the themes are appropriate and supported by the data collected. Thematic analysis was used as it allows for the generation of broad themes across the data. This was preferable as the participants had experience from different healthcare settings and the study was interested in their experience of behaviour change approaches, not purely the specific type of behaviour under investigation. Use of multiple coders supported triangulation of the codes and theme interpretation.

When developing the protocol for Chapter 4, alternative approaches to thematic analysis were considered. Framework analysis (Ritchie et al., 2013; Smith & Firth, 2011) is an analytical approach that involves similar steps of coding as thematic analysis. The data is organised using develop coding indexes and matrices. This was intended to allow for clear comparison of the perspectives on MI arranged through experience of using MI skills in practice or not. However, due to the very small number of participants not using MI skills in practice, this approach was not used. As an alternative, the themes were reviewed and considered with the level of practical experience reported by participants.

3. Definitions and terminology used in thesis

This thesis referred to MI as a person-centred approach. The definition of a person-centred approach is different to that of a client- or patient- centred approach. A person-centred approach is holistic and puts the individual (rather than their health status, or a specific treatment domain or desired outcome) at the core of the intervention goals.

This thesis used person-first language. There are ongoing discussions within the research community and advocacy and social contexts about the correct terminology to use to refer to obesity and related concepts (Kyle & Puhl, 2014). Some individuals and organisations prefer to use different identifiers, and this relates to the wide range of experiences of living with excess bodyweight. For example, some individuals prefer to use ‘an obese person’ rather than ‘a person with obesity’ which can be perceived as labelling bodyweight as a problem and a cause of weight stigma. In line with the European Association for the Study of Obesity and European Coalition for People living with Obesity (European Association for the Study of Obesity Patient Council (EPCO), 2019; The European Association for the Study of Obesity (EASO), 2016) position statement, which is supported by patient representatives, this thesis used a person-first approach which puts the noun first and the condition second. For example, ‘*a person living with obesity*’. It is important to recognise that this is an ongoing conversation and there may be changes to the language and terminology surrounding obesity that is used in the future.

4. Summary of analysis methods used

This thesis used several methods of analysis to investigate the overall research aims. Firstly, a meta-analysis (Chapter 3) was utilised to provide a quantitative summary of the effectiveness of MI for weight-related outcomes such as BMI (kg/m^2) and bodyweight as reported within randomised controlled trials with adults living with obesity as participants. The data was collected through a systematic review of relevant literature and provided an update to earlier meta-analyses.

Secondly, a qualitative thematic analysis was used for the first empirical study (Chapter 4). This study utilised a thematic analysis approach as it was unclear from the previous literature what the perspectives of practitioners could report as core components of the effectiveness of MI when delivered for a range of behaviour change target domains in practice. A thematic analysis approach allowed for the participant experiences to formulate the important contributors without imposing a top-down framework that may have been more closely related to the researcher's experience and knowledge of behaviour change theory.

Thirdly, a quantitative analysis was pre-specified for two empirical chapters (Chapter 5 and Chapter 7). These are discussed in greater detail in the relevant chapters and a summary is provided here. For the single-group design analysis, a longitudinal repeated measures analysis of variance (ANOVA) was planned which would allow for the multiple sessions to be accounted for within the analysis model. However, this was limited by the eventual participant sample size which meant the data was underpowered and the analysis would therefore be inappropriate to complete. As an alternative, the data was assessed through reporting of descriptive statistics and the use of effect size reporting to provide the reader with a view of the impact of the sessions on participant change to behavioural determinants and behaviours.

For Chapter 7 (the randomised control study involving an active intervention group and a time-matched information provision comparator group), initial plans were to conduct a repeated measures ANOVA which would assess the effectiveness of the intervention through its impact on bodyweight, behaviours, and behavioural determinants. However due to attrition levels, data were not complete

enough to conduct this analysis. Therefore, the exploratory hypothesis was investigated using descriptive statistic reporting as an alternative.

For both Chapter 5 and Chapter 7 the research intended to answer the question of what techniques are present within MI studies. To answer this, the researcher and colleagues completed MI-specific and BC technique coding of study audio. The findings were collated, and effectiveness ratios were reported. Effectiveness ratios were calculated as the number of times a technique was present within a session classed as effective at producing an improved score, divided by the number of times it was present at all in any session recordings.

5. Triangulation of study methods

Triangulation refers to the use of multiple research methods to develop an understanding of the phenomena under investigation (Patton, 1999) and how credibility and validity of the findings can be increased. This thesis includes multiple research methods (qualitative interviews with healthcare professionals; single group pre-post comparison trial of MI with individuals who have a specific behaviour change goal of physical activity increases; and randomised controlled trial approach to investigating the utility of MI for adults with obesity with a range of behaviour change goals). This thesis adopted a sequential approach to developing the next study based on findings from the previous study. This ensured the methods used were providing further insights and answers to the thesis question. A common thread of the studies was the aim of understanding what content was delivered within effective MI interventions within this context.

6. Research ethics of participant involvement

Key ethical considerations included recruitment approaches; recruitment support from stakeholder avenues; anonymity and protection of participant privacy; sensitive topics, risk assessments and distress protocols; and data protection and storage requirements.

6.1. Recruitment approaches

Recruitment of participants used multiple avenues to identify a diverse sample. This included paper and online advertisements disseminated on the University campus and announcement systems, online website, and social media advertisements, mailing lists, and word of mouth. Advertisements included the contact email address of the PhD researcher to ask for more information about the study.

Challenges in recruitment were encountered with the healthcare professional qualitative study (Chapter 4). Initial plans were to recruit individuals who worked in contexts that used behaviour change approaches and had experience of MI training but did not consider themselves to use MI skills. The aim of this was to allow for comparison between MI and other approaches to behaviour change to clarify what is different about the content and delivery of MI. However, this was a difficult population to recruit. Two individuals responded to the study advertisement as non-MI skill users; however, during the interviews it emerged that one individual did consider themselves to use MI skills but not in their current (non-patient facing) professional role. Therefore, to address this in the analysis, the level of MI use (e.g., “I use MI skills every day”) was coded to provide an overview of how levels of experience may inform understanding of the content of MI.

6.2. Participant recruitment support (recruitment via Obesity UK, EASO)

Recruitment processes benefitted from support from patient groups and clinician organisations. The patient and clinician organisations included the European Association for the Study of Obesity (EASO) who shared the healthcare professional qualitative interview study advertisement with their professional membership (Chapter 4). Links were also forged with Obesity UK, a patient-led support group for pre- and post-bariatric surgery patients. Obesity UK shared the advertisement for the interventional study with their member groups, who are based in multiple locations across the UK (Chapter 7).

6.3. Ethical considerations: participant anonymity

To ensure that participant anonymity was maintained, several procedures were put in place. For the qualitative interview study, and interventional studies, data management plans were developed and adhered to. For paper records, the participant identification (ID) number was not attached to documents with the participant's name or contact details. During transcription, any identifying information (e.g., place or people's names) were redacted. Electronic data (e.g., electronically returned consent forms, redacted transcripts, and separately stored contact details) were stored in files and folders encrypted using a password. Only the research team named on the ethics application had access to the study data. All participants were advised that they would not be identified unless content discussed in the interview revealed a risk of harm to the participant or others.

6.4. Sensitive topics

An important ethical consideration is the discussion of sensitive or potentially distressing conversation topics during the qualitative interview study (Chapter 4) and the MI session intervention studies (Chapters 5 and 7). At the start of the interview, participants were advised they did not have to answer any questions they would prefer not to, and that they could take a break at any time. In advance of the intervention study starting, the research team (myself and my supervisors) met to discuss steps to take in case of participant distress. This included advising at the start of the session that anything indicating the participant or others were at risk of harm may require confidentiality to be broken. A debrief form was developed which provided a reminder of the research title, ethical review approval number, and links to support and advice for wellbeing, and the contact details for myself and my supervisor (Dr Anna Chisholm). Links to the NHS website (https://www.nhs.uk*),* Patient (https://patient.info/), and Mind (https://www.mind.org.uk/) were provided. In addition, recommendations to contact their GP and telephone numbers for the NHS 111 service, Samaritans, and the Campaign Against Living Miserably (CALM) were provided. The debrief form was provided after every session (Appendices o and v). I also identified appropriate actions to take in case of distress. This included steps of acknowledging the participant may be feeling distressed or expressing

discomfort in their language or vocal tone, pausing the interview to check if they were feeling alright, and asking for permission to restart the interview and recording. If participants experienced distress during the session, the researcher would also follow up via email afterwards. Resources for the researcher were also identified in terms of the appropriate protocols to follow for participants who appeared at risk of harm. This included reporting to the PhD supervisor immediately and University Ethics Committee to identify the appropriate signposting or further referral (e.g., identifying available support services).

6.4.1. Risk assessments

All studies involving participants (Chapter 4, Chapter 5, and Chapter 7) were risk assessed by the PhD researcher and the risk assessment approved by the Department of Psychology Health & Safety team. All studies were assessed as low risk. Copies of risk assessments are included in Appendix b and Appendix j.

6.5. Summary of ethical approvals sought

A number of ethical approvals were sought for the research studies reported in Chapters 4, 5, and 7 from the University of Liverpool Health and Life Sciences Research Ethics Committee. The research design (purpose and objectives, recruitment and sampling approach, study procedures and documents, analysis plans, data management) and participant-facing materials (participant information sheet, study advertisements, consent forms, questionnaire measures, and debrief forms) were submitted to the University of Liverpool Ethics Committee for review. Approval was granted for the relevant studies. Ethical approval was not required for the desk-based systematic review and meta-analysis literature presented in Chapter 3. For the qualitative research study presented in Chapter 4, the reference number for the study was 3479 (Appendix A). The single-group, physical activity behaviour intervention reported in Chapter 5 was approved by the committee with reference number 5724 (Appendix i). The weight-related behaviour change intervention reported in Chapter 7 was approved by the committee as an amendment to application 5724 (Appendix q). Copies of the ethical approval letters are included within Appendices A, I and Q.

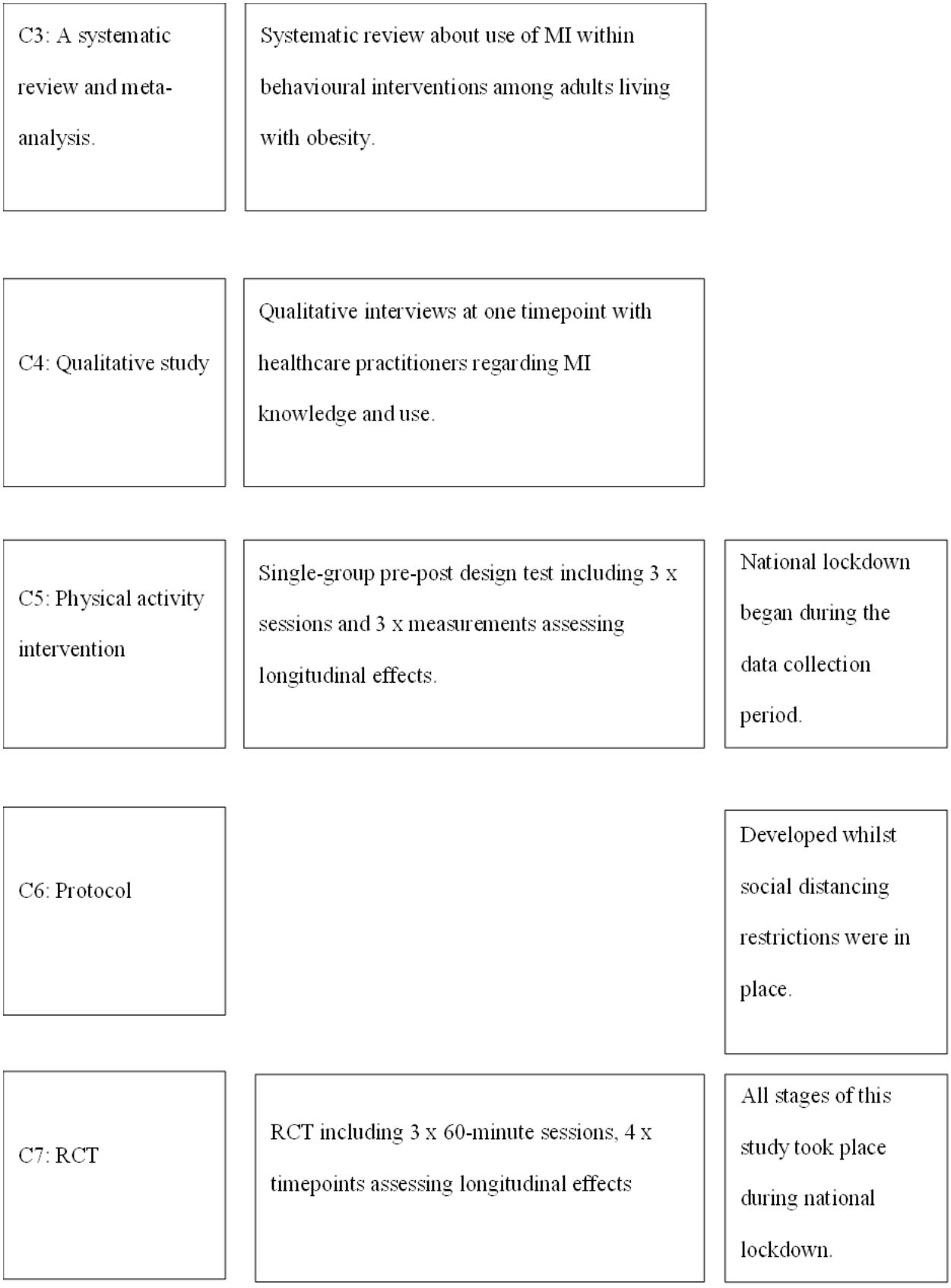

Figure 1. Diagram representing empirical research chapters (and any impacts of COVID-19)

Chapter 3. Use of motivational interviewing in behavioural interventions among adults with obesity: A systematic review and meta-analysis

Foreword

To understand the use of Motivational Interviewing (MI) within obesity contexts, a systematic review and meta-analysis was planned. The aim of this work was to identify if MI is a beneficial approach to support bodyweight reduction within an adult population. Furthermore, the review aimed to identify what specific elements of the intervention were present within the methods used in published research papers, the theorised mechanisms of this complex approach, and to inform how MI is applied as an intervention in this area.

The formatting of this chapter, including referencing format, is presented as published in Clinical Obesity[2]. Only minimal changes have been made to the presentation of this chapter to ensure consistency with the overall thesis including updated referencing and figure and table numbering.

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[2] Makin, H., Chisholm, A., Fallon, V., & Goodwin, L. (2021). Use of motivational interviewing in behavioural interventions among adults with obesity: A systematic review and meta-analysis. *Clinical obesity*, *11*(4), e12457.

Abstract

This review aimed to identify whether Motivational Interviewing [MI] (a counselling approach for supporting behaviour change [BC]) helps to reduce bodyweight and BMI in an adult obesity context. This included evaluating effectiveness of MI interventions within this population and reporting the methodology used, including theoretical underpinnings and identification of BC and MI techniques.

Eight databases were searched using controlled vocabulary. Eligible studies included adults with obesity (BMI ≥30 kg/m^2), author-reported interventions using MI aiming to reduce body weight or BMI, and comparator groups not receiving an MI intervention. Data extraction and quality appraisal tools were used to identify study characteristics, intervention content was coded for techniques, and random-effects meta-analysis were conducted to investigate effects.

Meta-analysis of 12 studies indicated no overall pooled effect on bodyweight and BMI outcomes between intervention and control groups (SMD=-0.01 (95%CI -0.13 to 0.12, p=.93). Findings were limited by multiple sources accounting for risk of bias, and poor reporting of intervention fidelity and content. Intervention and control content descriptions indicated similar techniques, with social support, goal setting (behaviour) and self-monitoring of behaviour occurring most frequently across both.

Findings do not contribute additional evidence for MI use in this context, however methodological limitations were identified which must be resolved to better identify the intervention effects on obesity-related outcomes.

1. Introduction

Worldwide, researchers estimate that the prevalence rate of obesity has nearly tripled since 1975, meaning that 39% of adults have overweight and 13% have obesity (World Health Organisation, 2021). In the European region, up to 47.6% of adults are predicted to have obesity or overweight (Gallus et al., 2015). Obesity is characterised by excess body weight and is defined in the United Kingdom and United States as a Body Mass Index (BMI) of 30 and higher (Bray et al., 2016). It holds serious implications for health including an increased risk of illnesses such as Type 2 diabetes, hypertension and cardiovascular disease when compared to individuals without obesity (NHS Digital, 2016). Research has identified a multifactorial basis for the condition, stemming from genetic, behavioural, environmental, and social aspects (Bray et al., 2016) which may be impacted by the obesogenic environment (Friedman, 2009). These prevalence rates indicate need for development of evidence-based, effective interventions that reduce bodyweight and the risk of adverse health outcomes. Particularly important is identification of interventions that can be implemented in a range of settings to boost accessibility of effective treatment through methods such as telehealth(Barnes & Ivezaj, 2015; Patel et al., 2019).

Motivational Interviewing (MI) is a communication approach designed to assist an individual in reducing ambivalence about behaviour change, via four core processes: engaging with an individual, focusing on specific behaviours to change, evoking change talk, and planning to enact change (Miller & Rollnick, 2013). It is a patient-centred, non-judgemental, directive set of skills utilised by practitioners to discuss changing patient behaviours for improved health outcomes. Skills that align with the core spirit of MI (partnership, compassion, evocation, and acceptance) and aim to respect the individual's autonomy and build upon motivation for change are used. These include open-ended questions, affirmations, reflective statements and expressions of empathy amongst other recently defined specific skill (Hardcastle et al., 2017). MI is one approach used to support preparation for behaviour change and maintenance of progress within weight-loss settings through raising motivation, self-efficacy and improving adherence to other weight-related interventions (Moss et al., 2017). Whilst there is evidence across health behaviour settings such as alcohol and substance use (Lundahl

et al., 2010; Smedslund et al., 2011), there are less conclusive findings as to the appropriate quantity and delivery of MI within obesity care. In 2019, Patel and colleagues (Patel et al., 2019) identified 15 trials utilising MI within telehealth settings for weight loss in adults living with overweight and obesity and found it performed better than no treatment in around 54% of 11 occasions, but in the majority of cases using an active comparator, MI did not perform better. Armstrong and colleagues (Armstrong et al., 2011) conducted in 2011 a meta-analysis of randomised controlled trials recruiting adults with overweight and obesity, and identified an overall significant, moderate (SMD = 0.51) effect of MI to improve weight loss over comparator interventions such as treatment as usual and advice from non-MI trained practitioners. Barnes and colleagues' recent review of papers utilising MI with adults with overweight and obesity (Barnes & Ivezaj, 2015) drew similar narrative conclusions to the earlier findings with 54.2% of included studies reporting clinically significant weight loss of at least 5% baseline body weight, although this did not quantitatively synthesise findings using meta-analytic techniques. Providing greater detail about specific intervention components, such as which skills are utilised, would assist with ensuring methodological replication. This would also allow identification of intervention components necessary for effective weight loss and maintenance.

One way to provide greater specificity within intervention reporting is to code descriptions for behaviour change techniques (BCTs). BCTs are formal descriptors for the active components of behaviour change interventions that are "observable, replicable, and irreducible…designed to alter or redirect causal processes that regulate behaviour" (Michie et al., 2013) and can be utilised to provide more specific detail about what was delivered within interventions. Understanding of relevant BCTs may assist in replication and therefore, development of effective, targeted interventions. A taxonomy of 93 techniques clustered into 16 groups has been created by Michie and colleagues (Michie et al., 2013) for use within intervention design and reporting. Within the obesity management context, health authorities have recommended use of techniques such as goal setting (1.1), self-monitoring of behaviour (2.3), review of behavioural goals (1.5), feedback on performance (2.2) and action planning (1.4) as effective for weight loss outcomes (Public Health England, 2017). Accounting for the fact that MI includes techniques additional to those defined within existing taxonomies, researchers have

recently developed a taxonomy of techniques specific to MI (Hardcastle et al., 2017) which can be used to clarify what is occurring within MI implementation. There is currently no clear understanding of the influence of techniques within MI interventions for obesity-related outcomes. Previous reviews have not explicitly identified the BCTs reported in published trials of MI for weight outcomes through coding the intervention design specifically within MI and weight loss contexts, but recent research has begun to identify techniques present within in-person physical activity counselling sessions(Gagnon et al., 2018). MI is a popular approach and further investigation to clarify the efficacy of the intervention and its individual components is required. The use of Hardcastle and colleague's technique framework will support identification of present components in MI interventions.

The primary objective of this review was to investigate the effectiveness of MI for adiposity outcomes in populations with obesity aiming to lose bodyweight, and to evaluate its effectiveness utilising meta-analytic methods. Additionally, the review aimed to report the presence of BCT and MI specific techniques, and theoretical underpinnings in MI research to inform understanding of how MI is utilised in research. Specifically, this review aimed to synthesise studies of participants with obesity that included at least one group receiving an intervention of MI and a non-MI comparator group, and reported outcomes of bodyweight including BMI and kilograms as change scores or final measurements.

2. Methods

Methods are reported in accordance with the Preferred Reporting Items for a Systematic Review and Meta-Analysis guidelines (PRISMA; Shamseer et al., 2015). The protocol can be accessed from PROSPERO (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42018114697).

2.1. Study eligibility

For inclusion, trials were required to recruit adults (18 years and above) with a BMI of 30 kg/m^2 and higher examining the use of MI for the reduction of bodyweight. Trials needed include at least one arm providing MI and one arm offering a comparator without MI. Studies required at least one follow-up point and the full text needed to be available in English. Both published and unpublished

work was eligible for inclusion. Cross-sectional or single-group studies were not eligible, nor were studies recruiting participants with obesity as a result of a pre-existing condition or as a secondary effect of medication.

2.2. Search strategy

Original searches took place 13th-16th March 2018 and were updated in 2020. The following databases were searched from 2002 to 25th November 2020: CINAHLPlus, Cochrane Library, ProQuest Dissertations International, PsycINFO, PubMed (covers Medline), Scopus, Web of Science, University of Liverpool search facility (covers CINAHLPlus, PsycINFO, PubMed, Scopus, Web of Science). This date was selected due to the publication of the second edition of a textbook published by Miller & Rollnick (Miller & Rollnick, 2013). Articles published before 2002 may utilise vocabulary or concepts since updated. Searches were developed through locating key terms from published articles, controlled vocabulary, and initial results from scoping searches to develop comprehensive strategies dependent on the search database of interest. Broadly, the following key words combined with Boolean operators were used: Motivational Interviewing, weight loss, weight reduction, obesity**.** Additionally, database-specific search strategies were employed for the following databases: Medical Subject Headings (MeSH) for PubMed and the Cochrane Library, and Thesaurus of Psychological Index Terms for PsycINFO. Articles were stored using Microsoft Excel for screening and data extraction and Review Manager 5.3 software (Cochrane Collaboration, 2013) for assessing risk of bias and meta-analysis.

After removal of duplicates, researchers screened the remaining articles at title, abstract and full-text level. Papers were assessed with responses of ‘yes’, ‘no’, or ‘unclear’ for eligibility characteristics. Articles assessed as ‘yes’ or ‘unclear’ were included for the next stage. Screening was carried out by one researcher with 25% second-screened by an external researcher.

2.3. Risk of bias

Papers were assessed for risk of bias following data extraction. Randomised controlled trials were assessed using the Cochrane Collaboration risk of bias tool. This determines a separate value for

each type of bias, and determining an overall risk level for each paper is not recommended (Cochrane Collaboration, 2020) but permits comparison. This assessed each paper for bias related to; random sequence generation and allocation concealment, blinding, blinding of outcome assessment, attrition and selective reporting as high, unclear, or low risk. 50% of studies were assessed for by a second researcher. Disagreements were resolved through discussions. Nonrandomized articles were assessed for risk of bias using the Newcastle-Ottawa quality assessment scale (Wells et al., 2000) which utilises a starring system to report on selection, comparability, and outcome.

2.4. Extraction of data

Where multiple intervention arms were in place, the most passive intervention with data reported was selected as the comparator. This was defined as the arm closest to providing treatment as usual/no treatment. Outcome measurements from baseline and the latest follow-up point were extracted as reported. Additionally, behavioural measures such as outcomes of physical activity or dietary intake were extracted. Where multiple papers were published on the same dataset, the latest possible follow-up point was used for extraction and earlier papers reviewed for methodological information.

Data extraction forms were designed using the template for intervention description and replication checklist (TIDieR; (Hoffmann et al., 2014)). This included a description of the intervention delivery methods and content, interventionist backgrounds, setting, and frequency. Information regarding the use of fidelity tools was extracted if reported. The primary outcome was measures of adiposity, such as BMI and weight in kilograms. Secondary outcomes of interest were measures of motivation or adherence to other treatments, such as behavioural weight loss programmes (BWLP). Where reported, both BMI and bodyweight information was extracted. Also extracted was information about attrition, reasons for drop-out and how analyses handled this, such as use of intent-to-treat analysis or data transformation. 25% of papers were extracted a second time by a researcher external to the research team to confirm accuracy of extraction.

2.5. Coding of Behaviour Change Techniques and MI techniques

Intervention content was coded for techniques in line with the Behaviour Change Technique Taxonomy v1 (BCTTv1;(Michie et al., 2013) and MI-specific techniques, including content-based (e.g. agenda mapping) and relational techniques (e.g. offer emotional support) as defined by Hardcastle and colleagues (Hardcastle et al., 2017). Intervention techniques were coded only when clearly present and applied to a target behaviour related to the outcome behaviour (e.g. weight loss through dietary or nutritional changes, activity level changes, adherence to other intervention designed for weight loss outcomes such as BWLP). Intervention content was examined through the published article, any supplementary materials and protocols. Intervention technique coding was conducted by one researcher (HM) and 50% were second coded (AC). Intervention and comparator descriptions were reviewed and each technique noted as present or absent. Both researchers completed the BCTTv1 online training module and coded using agreed definitions. Any discrepancies were resolved through discussion. To quantify agreement between coders, prevalence-adjusted bias-adjusted kappa statistics (Byrt et al., 1993) were calculated for each set of coding. Use of prevalence and bias adjusted kappa allows for a high prevalence of absent or present responses from the coders and is reported in addition to Cohen's kappa (Cohen, 1968).

2.6. Data analysis plan

Quantitative data was synthesised using Review Manager 5.3 (Cochrane Collaboration, 2013). Reported outcome measurements differed between studies. Both BMI and bodyweight in kilograms were reported as change scores or final measurement values; to examine the pooled effect, only final measurement values for these were inputted as means and standard deviations (SD) to Review Manager as more papers reported this outcome rather than change scores. As BMI and bodyweight in kilograms represent different scales it was not possible to combine both change and final value measurements from each scale within a SMD meta-analysis. The final measurement of both outcomes were pooled within an SMD meta-analysis. If SDs were not reported, they were calculated from 95% confidence intervals or standard error using procedures from the Cochrane Handbook (Higgins, 2011).

Where papers reported both BMI and bodyweight, BMI was selected for inclusion within pooled effects analysis. Additional analyses using Mean Difference were not pre-specified within the review protocol. Papers were grouped by the outcome measure of weight in kilograms and BMI and each outcome type examined in a separate analysis. This allowed for the examination of pooled change from baseline and final measurement scores within each scale individually, as it is assumed that the SD represents the same thing (Higgins, 2011), increasing the number of studies that could be included in analyses.

Review Manager weighted the effects according to sample size and provides a mean difference (MD) or standardised mean difference (SMD) score along with a significance value and 95% confidence intervals for continuous data. Heterogeneity was assessed by checking I^2 values. This was examined using a significance cut-off of $p<.10$ with percentages of 0-40% for potentially not important, 30-60% as moderate, 50-90% as substantial and 75%+ for significant heterogeneity (Hoffmann et al., 2014). It was expected due to differences in MI delivery and study populations that significant heterogeneity would be present and therefore random effects meta-analyses were conducted.

3. Results

The number of papers assessed for inclusion is summarised in Figure 2. Initial database searches yielded 1588 records. Following title and abstract screening, 157 full texts were screened for inclusion. The most frequent reasons for exclusion were a non-Motivational Interviewing intervention or single group design. 31 papers were deemed appropriate for inclusion in the review with high reliability between researchers for the screening process ($k = 0.75$). Figure 2 reports the identification of studies.

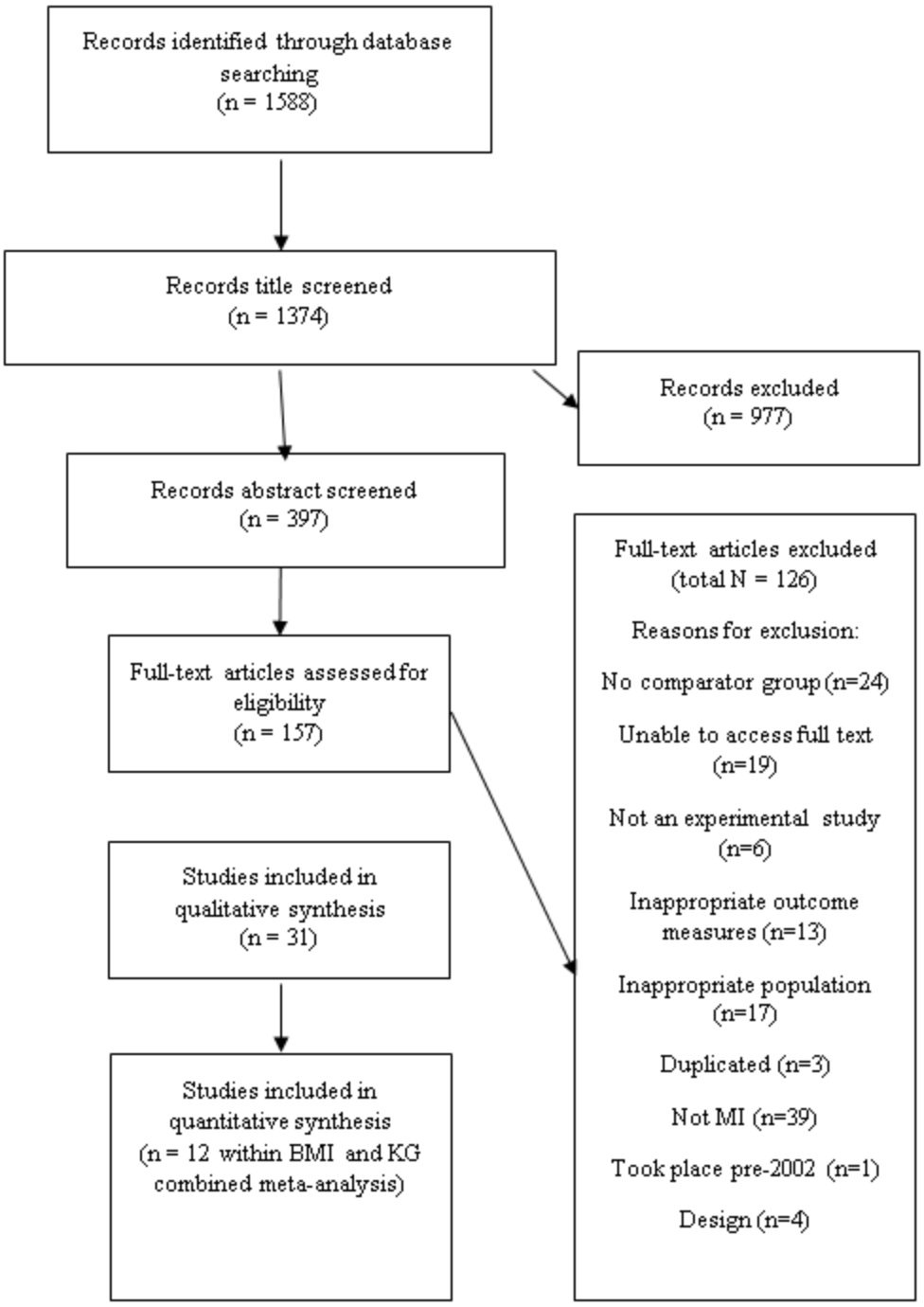

Figure 2. PRISMA flow diagram

3.1. Study characteristics

Publication dates ranged from 2008 to 2020. Sample sizes ranged from 19 to 864 with 6249 participants recruited across all studies. Participants were recruited from settings including primary (n = 12 (Befort et al., 2008; Bräutigam-Ewe et al., 2020; Chee et al., 2017; Greaves et al., 2008; Groeneveld et al., 2010; Hardcastle et al., 2013; Huber et al., 2015; Penn et al., 2009; Rodriguez-

Cristobal et al., 2017; Saffari et al., 2014; Simpson et al., 2015)) and specialised healthcare (n =9 (Anderson et al., 2014; Braun et al., 2018; Groeneveld et al., 2010; Karlsen et al., 2013; Lewis et al., 2011; Littman et al., 2019; Low et al., 2013; Mirkarimi et al., 2017; Moeller et al., 2019; Sun et al., 2020)), fitness centres (n = 1 (Moss et al., 2017)), and education centres/workplaces (n=2, Buscemi et al., 2011; Olson et al., 2016) and community-based advertisements (n=6, Carels et al., 2007; DiMarco et al., 2009; LaRose et al., 2020; Meybodi et al., 2011; Smith West et al., 2007; West et al., 2016). Recruitment methods were unclear for 1 paper (West et al., 2011). Where reported, average BMI of the total sample ranged from 32.86 to 47.80 kg/m^2. Average age ranged from 19 years for an intervention designed for college students to 63 years for a population recruited through health screening services. Comparator conditions were behavioural weight loss programs without MI elements(Carels et al., 2007; DiMarco et al., 2009; Smith West et al., 2007; West et al., 2011, 2016), treatment as usual (Anderson et al., 2014; Chee et al., 2017; Groeneveld et al., 2010; Lewis et al., 2019; Penn et al., 2009; Rodriguez-Cristobal et al., 2017; Simpson et al., 2015), non-MI content of a similar duration (Barnes et al., 2017; Befort et al., 2008; Karlsen et al., 2013; LaRose et al., 2020; Moss et al., 2017) use of traditional advice or leaflets (Bräutigam-Ewe et al., 2020; Buscemi et al., 2011; Huber et al., 2015; Littman et al., 2019; Low et al., 2013; Mirkarimi et al., 2017; Moeller et al., 2019; Saffari et al., 2014; Sun et al., 2020) and waitlists (Meybodi et al., 2011; Olson et al., 2016). Several nonrandomised (Braun et al., 2018; Karlsen et al., 2013) and cluster randomised trials (Olson et al., 2016; Rodriguez-Cristobal et al., 2017; West et al., 2011) were identified through searches and are narratively discussed to provide understanding of intervention methodology. Randomisation status was unclear for three studies (DiMarco et al., 2009; LaRose et al., 2020; Low et al., 2013). Cluster-randomized trials were not included in meta-analysis of effects to avoid over precise confidence intervals resulting from unit-of-analysis errors, and non-randomized trials were not included as confidence intervals may not truly reflect effects (Higgins, 2011). 18 studies reported both bodyweight (KG) and BMI data. See Table 4 for a summary of characteristics.

The most frequent mode of delivery was face-to-face, identified in 25 papers. Four studies used a group format of MI. Some studies utilised distance methods to investigate scalability of MI. 15 papers

used telephone or online methods of delivering sessions with components of Motivational Interviewing. 10 of these used a distance format in addition to face-to-face methods (Table 4). Duration of in-person MI sessions ranged from 90 minutes over three months in addition to a behavioural program in an individual format (Moss et al., 2017) to 32 hours over 26 months in group settings (Rodriguez-Cristobal et al., 2017), with a median of 180 minutes overall. Discounting one study of a brief in-person session and follow-up 'booster calls' two weeks later (Buscemi et al., 2011), MI telephone sessions ranged from 120 minutes over four months (Befort et al., 2008) to 374 minutes over six months (Greaves et al., 2008). Participants receiving telephone MI sessions in addition to face-to-face contact had a median 140 minutes of MI. The timepoint used was between 1 and 6 months for 8 studies (Befort et al., 2008; Braun et al., 2018; Buscemi et al., 2011; DiMarco et al., 2009; LaRose et al., 2020; Lewis et al., 2011; Littman et al., 2019; Low et al., 2013, 2013; Meybodi et al., 2011; Mirkarimi et al., 2017), 6 months for 9 studies (Braun et al., 2018; Carels et al., 2007; Greaves et al., 2008; Huber et al., 2015; Mirkarimi et al., 2017; Moeller et al., 2019; Moss et al., 2017; Olson et al., 2016; Sun et al., 2020), 12 months for 6 studies (Anderson et al., 2014; Barnes et al., 2017; Chee et al., 2017; Groeneveld et al., 2010; Saffari et al., 2014; Simpson et al., 2015), 13 to 24 months for 6 studies (Bräutigam-Ewe et al., 2020; Hardcastle et al., 2013; Rodriguez-Cristobal et al., 2017; Smith West et al., 2007; West et al., 2011, 2016), 5 years for one study (Penn et al., 2009) and unclear for one (Karlsen et al., 2013).

Reported interventionist backgrounds included undergraduates, nurses, dieticians and psychologists. 17 papers gave no information on training or qualifications. Where reported, training duration ranged from between four and eight hours to three days. Regarding fidelity, 58% of papers (Anderson et al., 2014; Barnes et al., 2017; Bräutigam-Ewe et al., 2020; Buscemi et al., 2011; Chee et al., 2017; Hardcastle et al., 2013; Huber et al., 2015; Lewis et al., 2019; Low et al., 2013; Meybodi et al., 2011; Mirkarimi et al., 2017; Moeller et al., 2019; Moss et al., 2017; Penn et al., 2009; Saffari et al., 2014) made no reference to use of supervision or measures. Other studies used the Motivational Interviewing Treatment Integrity measure (Moyers et al., 2016) (n=4 (Braun et al., 2018; Carels et al., 2007; LaRose et al., 2020; Simpson et al., 2015)) or the Behaviour Change Counselling Index (Lane

et al., 2005) (n=1 (Greaves et al., 2008)). Eight studies referred to supervision from trainer or researcher trained in MI to confirm consistency to the approach, through listening to audio recordings or reviewing transcripts (n=8 (Befort et al., 2008; DiMarco et al., 2009; Groeneveld et al., 2010; LaRose et al., 2020; Littman et al., 2019; Smith West et al., 2007; West et al., 2011, 2016)).

21 (Anderson et al., 2014; Barnes et al., 2017; Befort et al., 2008; Braun et al., 2018; Bräutigam-Ewe et al., 2020; Buscemi et al., 2011; Carels et al., 2007; DiMarco et al., 2009; Greaves et al., 2008; Huber et al., 2015; Karlsen et al., 2013; Lane et al., 2005; LaRose et al., 2020; Littman et al., 2019; Meybodi et al., 2011; Moeller et al., 2019; Olson et al., 2016; Penn et al., 2009; Saffari et al., 2014; Smith West et al., 2007; Sun et al., 2020; West et al., 2016) studies did not identify theories of behaviour used in intervention development. Of studies that did report theoretical underpinnings, the most common were Self-Determination Theory (n=3 (Hardcastle et al., 2013; Moss et al., 2017; Simpson et al., 2015), the Stages of Change/Transtheoretical Model (n=4 (Groeneveld et al., 2010; Hardcastle et al., 2013; Low et al., 2013; Rodriguez-Cristobal et al., 2017)), Social Cognitive Theory (n=2 (Mirkarimi et al., 2017; Simpson et al., 2015)), and Theory of Planned Behaviour (n= 1 (Hardcastle et al., 2013)). 180 BCTs were present in the intervention. The most frequently occurring BCT within the interventions was social support – unspecified (3.1), as MI is coded as 3.1 within the BCT taxonomy (Michie et al., 2013). Following this, goal-setting of behaviours (1.1) was identified in 12 intervention descriptions, and self-monitoring of behaviour (2.3) was identified in 15 descriptions. Consideration of the pros and cons (9.2) was identified in 9 intervention descriptions, and information about health consequences (5.1) in 9. Regarding comparator group methodological descriptions, 76 BCTs were identified in total. Most prominently these were self-monitoring of behaviour (2.3), appearing in 10 descriptions, social support – unspecified (3.1) coded in 9, instruction on how to perform behaviour (4.1) and information about health consequences (5.1) both present in 7 descriptions and goal-setting of behaviour (1.1) coded in 6. Regarding MI-specific techniques, of 38 defined by Hardcastle & colleagues (Hardcastle et al., 2017) 26 were identified within interventions (none identified within comparator arms). Most frequently identified was ‘develop a change plan’ (33), noted in 11 papers, and ‘running head start’ (9) identified in nine papers. Inter-rater agreement

was good for both BCT and MI technique coding (Cohen's kappa >0.80, prevalence-adjusted bias-adjusted kappa >0.60). See supplementary materials for frequency counts of BCT and MI-specific techniques.

Table 4. Study characteristics

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Anderson (2014). UK	329 adults (243 men,74 women), 50-74 years, BMI >25. Recruited through cancer screening services.	Stratified by trial site, single blind	63.6 (6.8) years. 99% white. 47% obese.	NR	Individual MI via face-to-face and telephone focusing on support for bodyweight reduction.	TAU including general information.	Yes, both groups	Individual	Face-to-face, telephone	To reduce overweight/ obesity through diet and PA.	1.1, 1.2, 1.3, 1.4, 1.5, 2.4, 2.7, 3.1, 5.1, 6.1, 9.1, 12.5	NR	12 months; 315 minutes.	NR	NR	10, 14, 17, 21, 31, 33, 35, 37	NR
Barnes (2017). US	59 adults (21 men,68 women) aged >18 years, BMI 25 - 55, recruited through primary care.	Stratified by Binge Eating Disorder diagnosis, single blind.	47.9 (10.5) years. Mean BMI 35.3 (7.0). 65.2% white, 27% African-American, 3% bi/multiracial, 7% bi/multiracial Hispanic.	35.3	Individual MI via face-to-face and telephone focusing on support for weight loss and treatment adherence.	Nutrition psychoeducation and internet attention control. Basic nutritional information and a website to track goals.	Yes, both groups	Individual	Face-to-face, telephone	To test effectiveness of scalable intervention for weight loss outcomes.	1.1, 1.3, 2.2, 2.3, 3.1, 6.1	1.1, 1.3, 2.3, 2.4	3 months; 140 minutes.	NR	NR	1, 33	NR
Befort (2008). US	44 adults (0 men, 44 women), aged >18 years, BMI 30 - 50, recruited through primary care.	Sequential randomisation, single blind.	44.3 (11.6) years. Mean BMI 39.80 (6.40). Ethnicity NR.	39.8	Individual MI via face-to-face and telephone focusing on building motivation and treatment adherence.	Health education attention control focused on providing didactic information and advice.	Yes, control only	Individual	Face-to-face, telephone	To investigate the addition of MI to a culturally-targeted group-based BWLP for AA women enhanced adherence, and additionally to explore effect of MI on diet and physical activity behaviours and weight loss outcomes, and motivation and self-efficacy.	1.1, 1.3, 2.3, 3.1, 3.2, 4.2, 5.1, 9.2, 15.3	1.1, 1.3, 2.3, 3.1, 3.2, 4.2, 5.1	4 months; 120 minutes.	Training from clinical psychologists including reading textbook, watching videotapes, 2-day workshop, conducting simulated counselling sessions.	25% of tapes randomly selected and reviewed weekly. Checklist used to rate extent to which counsellors captured the overall spirit of MI and adhered to MI strategies.	4, 9, 14, 21, 32, 33	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Braun (2018). US	29 adults, cancer survivors, recruited from local oncology clinics to take part in an urban garden intervention.	Nonrandomised, blinding NR.	Mean age of intervention participants 58. Mean age of control group participants 58. Control group 100% Caucasian, intervention group 76% Caucasian, 18% Black, 6% Asian.	NR	MI sessions offered weekly.	No MI.	Yes, both groups	Individual	Telephone calls, online video calls and email.	To investigate feasibility, efficacy, and acceptability of targeted tele-MI for cancer survivors with overweight and obesity.	2.1, 2.2, 2.3, 3.1, 4.1	2.1, 2.3, 3.1, 4.1	6 months; session duration NR.	4 x 2-hour one-to-one training sessions.	Random selection audio coded using the MITI by MI expert who provided MI training.	1,2	NR
Bräutigam-Ewe (2020). Sweden	299 adults with BMI between 28-35 recruited from primary care.	Consecutively randomised, participants blinded but not nursing staff.	Mean age 55.7 (7.1) years. Ethnicity NR.	Total sample mean weight 89(11.8) kg. Mean control group BMI 31.2 (1.9). Mean BMI intervention group 31.6 (2.1).	MI, grocery store lecture, website communication and weekly e-mails. MI conversations involved discussion of lifestyle and advise provided.	Traditional dietary advice.	Yes, both groups	Individual	Face-to-face	To evaluate the long-term effects of weight reduction and quality of life and sense of coherence in a primary healthcare-based intervention, and to compare the subgroups with low and high intensity to each other.	3.1, 4.1	4.1	24 months; duration NR.	3 x days of training	NR	NR	NR
Buscemi (2011). US	70 adults (10 men, 60 women). BMI 25-39. Recruited from college through survey about student health behaviours.	Stratified by gender and weight status (overweight and obese), methods of randomisation NR. Blinding NR.	19.69 (2.01) years. Mean BMI 32.83 (4.68). 32.9% Caucasian, 57.1% African American, 2.9% Hispanic, 2.9% Asian, 1.4% Pacific Islander, 2.9% other.	32.83	50-60-minute intervention with information about physical activity, dietary advice and portion sizes. Feedback on physical activity levels and diet. Booster phone call 2 weeks following.	Traditional dietary and activity advice.	Yes, both groups	Individual	Face-to-face, telephone	To develop a brief MI with behavioural component for college students with obesity/overweight focused on decreasing BMI and to compare to an assessment-only comparator.	1.1, 1.2, 2.2, 2.3, 4.1, 5.1, 9.2	2.3	3 months; 67 minutes.	20 hours of Motivational Interviewing training. Manual provided for sessions. Regular supervisions from psychologist.	NR	9, 20, 33	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Carels (2007). US	55 adults (9 men, 46 women). BMI >30. Recruited through advertisements in local newspapers and University e-mail.	Random number generator used for randomisation. Blinding NR.	48.00 (9.00) years. Mean BMI NR; Intervention group weight (kg) 101.60 kg (22.5), control mean weight (kg) 96.60 (22.1) kg.	NR	Group behavioural weight loss program emphasising gradual weight loss, physical activity increase, lifestyle change, and individual MI.	BWLP.	Yes, both groups	Individual	Face-to-face	To use MI sessions to achieve superior treatment outcomes compared to BWLP only comparator group.	8.7	8.7	6 months; 324 minutes (average of 5.4 sessions per participant).	NR	Randomly selected sessions coded using Motivational Interviewing Treatment Integrity (MITI).	NR	NR
Chee (2017). Malaysia	230 adults >30, <65 years, BMI >23, with Type 2 Diabetes A1c levels 7-11%. Recruited from primary care clinic.	Random allocation software used for randomisation. Unblinded.	Median age 55(8) years for intervention group and 54(8) years for control group. 14% Malay participants, 28% Chinese participants, 58% Indian participants.	NR	Two active intervention arms involving low-calorie meal plan and education about diabetes, one with MI and one with conventional counselling. C: usual care.	TAU.	Yes, both groups	Individual	NR	To examine effectiveness of the low-calorie structured lifestyle intervention in comparison to usual care for diabetes-related health outcomes.	3.1, 4.1	4.1	12 months; duration NR.	NR	NR	35	Social Cognitive Theory
DiMarco (2009). US	39 adults (7 men, 32 women). Age range 20-54. Recruited through advertisements.	Randomisation NR. Blinding NR.	Mean age 39.90 (8.84). Mean BMI 32.36 (3.05). Intervention mean BMI 33.06 (3.17), Comparator mean BMI 31.62 (2.81). 71.80% Caucasians, 7.7% African Americans, 5.1% Hispanic, 5.1% South Asians, 2.6% East Asians, 7.7% other.	32.36	Guided self-help and Motivational Interviewing.	BWLP Guided self-help.	Yes, both groups	Group	Face-to-face	To assess effectiveness of MI in addition to guided self-help in comparison to guided self-help for attrition, BMI change, eating behaviour, mood, and quality of life.	3.1, 9.2	3.1, 5.3	11 weeks; 120 minutes.	6 hours of training from psychologists.	Pilot session tapes and all intervention tapes reviewed by author. Fidelity measure use NR.	9	NR
Greaves (2008). UK	141 adults (51 men, 90 women). Age >18 years. BMI >28. Recruited	Randomly allocated using sealed envelopes prepared by chief	Mean age 54.6 years. Intervention group baseline weight 91.60	NR	individual MI covering dietary and physical activity recommendat	Traditional dietary and activity advice.	Yes, control only	Individual	Face-to-face, telephone	To see if changes in weight and physical activity could be achieved	1.1, 1.3, 1.5, 2.3, 2.4, 3.1, 8.7	5.1	6 months; 374 minutes.	2 days of MI training delivered by accredited trainer.	Yes; pilot transcripts checked using Behaviour Change	33, 36	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
	from primary care settings.	investigator. Researchers blinded.	(13.30) kg. Control group baseline weight 94.40 (14.20) kg. Ethnicity NR.		ions, action planning, and behavioural skill development.					with MI intervention.					Counselling Index (BECCI).		
Groeneveld (2010). Netherlands	816 adults (816 men). Aged 18-55 years, BMI >30. Recruited from the construction industry through health screening programmes. (2010)	Pre-stratified for work type (construction work and management) and randomised using Random Allocation Software. Researchers blinded.	Intervention mean age 46.90 (9.10) years. Intervention mean BMI 28.80 (3.50). Control mean age 46.20 (8.80) years. Control mean BMI 28.20 (3.60).	NR	telephone and face-to-face consultations using MI that discussed issues such as diet, physical activity or smoking. Information about cardiovascular disease risk profile provided. Pros and cons of behaviour change, willingness and readiness discussed.	TAU including CVD risk information.	Yes, intervention only	Individual	Face-to-face, telephone	To examine effects of individualised intervention using MI for health outcomes (smoking, physical activity, diet) compared to treatment as usual.	3.1, 9.2	3.1, 5.3	6 months; 300 minutes.	3-day MI training course including role-plays.	Evaluation of pilot conversations by the interventionists.	1, 4, 9, 33	Transtheoretical Model, Stages of Change, Precaution Adoption Process Model.
Hardcastle (2013). UK	358 adults (118 men, 340 women). Mean age 52.10 (0.58). BMI >28. Recruited from primary care centres through electronic database.	Randomised by a statistician. Researchers blinded.	52.10 (0.58) years. Mean BMI 33.65 (0.30). Ethnicity NR.	33.65	Face-to-face consultation with physical activity specialist or registered dietician trained in MI.	Traditional dietary and activity advice.	Yes, control only	Individual	Face-to-face	To assess the effects of MI in comparison to treatment as usual for cardiovascular risk.	1.9, 3.2, 9.2	5.1	18 months; 150 minutes.	8 hours of training in MI. Sessions tape-recorded, data coded and analysed, and feedback provided.	NR	5, 9, 10, 11, 33	Theory of Planned Behaviour, SDT, Transtheoretical Model.
Huber (2015). US	90 adults (23 men, 67 women) age range 18-70 years. BMI between 30 and 39.9. Recruited from primary care centre.	Computer generated randomisation. Researchers blinded.	Intervention mean age 48.30 (12.30). Comparator mean age 47.40 (14.10). Intervention mean BMI 36.50 (4.20). Comparator mean BMI 36.10 (3.90). Intervention 96% Caucasian,	NR	Participants received portion control plate, tele coaching from MI trained counsellor to discuss nutrition and physical activity.	Traditional lifestyle advice.	Yes, control only	Individual	Telephone	To investigate effectiveness of weight loss intervention utilising MI via telephone and a portion control plate.	1.1, 1.2, 1.4, 2.2, 2.4	NR	3 months; 140 minutes.	NR	NR	20, 31, 37	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
			4% other. Comparator 91% Caucasian, 9% other.														
Karlsen (2013). Denmark	241 adults (0 men, 241 women). Recruited from specialist care centre. BMI >30.	Non-randomised. Patients who did not receive MI were comparator group. Blinding NR.	Intervention mean age 30.00 (SD NR) years. Mean BMI 35.70 (SD NR). Comparator mean age 31.10 (SD NR) years. Mean BMI 34.90 (SD NR). Ethnicity NR.	NR	brief MI consultation with nurse.	Non-MI consultation.	Yes, both groups	Individual	Face-to-face	To motivate and maintain lifestyle change.	3.1, 15.1	NR	NR; average of 1.1 interview per month (duration unclear).	Educational courses.	NR	33	NR
LaRose (2020). US	47 adults aged 18-25 years with a BMI 25-45 were recruited from the community.	Randomisation NR. Outcome assessors blinded.	Mean age 21.9 (1.9) years. 53% non-Hispanic White, 26% Black, 11% Hispanic/Latino, 6% Asian and 4% multiracial.	Total sample mean BMI 33.2 (4.6).	Both arms received two in-person sessions with an interventionist. Sessions provided an overview of behavioural weight loss concepts and strategies and goal personalisation. Subsequent sessions were delivered via email. The MI-enhanced condition was adapted to reflect MI principles whilst delivering the same content.	Same content delivered in a non-MI way.	Yes, both groups	Individual	Face-to-face, email	To determine if the MI enhanced approach produced superior engagement and retention, and to establish if the intervention was a potentially viable model for clinically significant weight loss in young adults.	1.1, 1.3, 2.2, 2.3, 3.1, 4.1, 6.2	1.1, 1.3, 2.2, 2.3, 4.1	12 weeks; 2 sessions lasting 75-90 minutes.	2 x days of MI training and supervision meetings, use of a manual.	Audio recordings of sessions and coaching transcripts reviewed using the MITI weekly.	1, 8, 21, 31, 32, 37	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Lewis (2019). Australia	61 adults (47 women, 14 men). Age >18 years, access to mobile phone, recruited through obesity management service.	Stratified block randomised crossover trial. Blinding NR.	Total sample mean age 48 (12.6) years. Total sample mean BMI 47.8 (8.4). Ethnicity NR.	47.8	Intervention involved routine telephone calls and texts using MI (average duration 21 minutes) monthly for 4 months.	TAU from specialist service.	Yes, both groups	Individual	Telephone calls and texts.	To explore use of telephone calls and text messaging as tools supporting community-based obesity management program.	1.2, 1.3, 2.3, 3.1	1.2, 5.3	4 months; 84 minutes.	NR	NR	20, 37	Self-determination theory
Littman (2019). US	19 adults with lower extremity amputation, BMI >25, interest in weight-related behaviour change. Recruited from clinics and organisations serving amputees.	Randomised by computer and sequentially numbered opaque envelopes. Block randomised 1:1 according to level of amputation. Outcome assessors blinded to allocation.	Mean age 56 (10) years. 73% male. Ethnicity NR. Total sample mean BMI 34.9. Total sample mean weight 105.9 kg (16.4).	34.9	Tailored programme for individuals with lower extremity amputation involving 1 phone calls over 20 weeks. Also provided with written materials including diet, physical activity and self-monitoring information. Provided with pedometer, digital scales, calorie counts book.	Traditional dietary and activity advice, self-monitoring tools.	Yes, both groups	Individual	Face-to-face, telephone	To test the feasibility of recruitment and to evaluate if the intervention was acceptable and safe. Additionally, to obtain preliminary estimates of efficacy.	1.2, 1.3, 1.5, 2.3, 3.1, 4.1, 4.2, 6.1	2.3, 4.2, 5.1, 6.1	20 weeks; session duration NR.	NR	Call recordings reviewed by lead author.	20, 33, 37	NR
Low (2012). US	56 adults (30 men, 26 women) with obesity. Recruited from routine cardiology appointments.	Randomisation NR. Blinding NR.	Total mean age 61.20 (9.30) years. Total mean BMI 38.00 (4.80). Ethnicity NR.	38	face-to-face consultations with trained undergraduate students. General protocol followed.	Traditional dietary advice.	Yes, control only	Individual	Face-to-face	To test the effectiveness of MI over a 3-month period using a replicable protocol.	3.1	3.1	3 months; 180 minutes.	2 days of MI training.	NR	NR?	Transtheoretical Model, Stages of Change.

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Meybodi (2011). Iran	30 adults (0 men, 30 women). 18-55 years. Recruited from notices.	Randomised, methods unclear. Blinding NR.	Age NR. Intervention group baseline BMI 30.61 (3.14). Comparator group baseline BMI 31.51 (3.70). Ethnicity NR.	NR	Participants received 4 MI sessions.	Waitlist.	NR.	Individual	Face-to-face	To decrease weight.	3.1	NR	NR	NR	NR	NR	NR
Mirkarimi (2017). Iran	100 adults (0 men, 100 women). BMI 25-35. Recruited from clinical records at a nutrition clinic.	Random block allocation used. Researchers blinded.	MI group mean age 36.30 (8.90. MI group mean BMI 28.25 (2.21).Control group mean age 39.90(9.10). Control group mean BMI 28.80(1.59)	NR	Group motivational Interviewing. Discussed importance of overweight and obesity, causes and implications.	Traditional dietary advice.	Yes, both groups	Group	Face-to-face	To investigate effect of MI on a weight loss programme in order to improve weight efficacy lifestyle.	1.1, 1.8, 1.9, 3.1, 4.2, 15.1	NR	0.5 months, 600 minutes.	NR	NR	NR	Social cognitive learning theory, Protection Motivation Theory.
Moeller (2020). Denmark	37 adult women with polycystic ovary syndrome and obesity, recruited from hospital setting.	Randomised by computer in blocks of 2 and 4. Authors blind to allocation.	Median age of the control group was 27. Median age of the MI group was 34. Median BMI of the control group was 35.9(range 33.9 to 38.8). Median BMI of the MI group was 37.6(range 35.2 to 48.1). Ethnicity NR.	NR	standard advice about diet, lifestyle and weightloss and MI.	Traditional dietary and lifestyle advice.	Yes, both groups	Individual	Face-to-face, video calls.	To investigate if MI as an add-on to standard advice improved weight loss and increased quality of life in women with obesity with PCOS compared to standard advice only.	3.1, 4.1	4.1	6 months; session duration NR.	MI sessions led by a certified MINT trainer.	NR	NR	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Moss (2017). Canada	135 adults (30 men, 105 women). BMI >25. Recruited through gym.	Computer generated randomisation. Participants blinded.	Mean age 45.16 (11.30) years. Mean BMI 33.58 (6.26). MI group mean age 45.56 (9.78) years. Mean BMI 33.78 (5.98). Control group mean age 44.67 (12.91) years. Control group mean BMI 33.37 (6.58).	33.58	Behavioural weight loss program focusing on sustainable weight loss and lifestyle changes, and brief MI sessions.	Semi-structured interview addressing health equivalent duration to intervention.	Yes, both groups	Individual	Face-to-face	To examine effectiveness of MI and BWLP on weight outcomes in comparison to attention control	1.4, 3.1, 4.1, 6.1, 8.1, 9.2, 15.1	1.4. 4.1, 6.1, 8.1	3 months; 90 minutes.	NR	NR	9, 32	Self-determination theory,
Olson (2016). US	452 adults (452 men, 0 women). BMI >27, recruited through transportation companies.	Cluster randomisation. Unblinded.	Total sample means NR. Intervention mean age 47.90 (11.20) years. Intervention mean BMI 35.73 (8.77). Control group mean age 47.60 (11.60). Control group mean BMI 35.44 (8.96). Intervention condition 1.8% Native American, 9.8% African American, 74.7% White, 6.2% >1 race, 7.6% Other. Control 0.9% Native American, 0.4% Asian, 1.4% Pacific Islander, 5.0% African American, 82.6% White, 5.9% >1 race, 3.7% Other.	35.73	6-month weight-loss competition within clusters. Supported by bodyweight and behavioural self-monitoring on website, computer-based training, and MI via telephone.	Waitlist.	Yes, control only	Individual	Telephone	To investigate effect of MI on BMI, diet, blood pressure, physical activity and sleep in comparison to control.	1.1, 1.3, 1.9, 2.2., 2.3, 2.4, 2.7, 3.1, 6.2, 10.1, 10.10, 12.5	NR.	4 sessions, duration NR	MINT members	Lead coach supervised process and monitored adherence to MI technique.		NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
Penn (2009). UK	102 adults (42 men, 60 women). Age ≥40 years. BMI ≥25. Recruited from primary care physician referral for at risk of impaired glucose regulation.	Pre-prepared random allocation lists stratified by sex and glucose values. Researchers and participants unblinded, data collection staff blinded where possible.	Intervention mean age 56.80 years. Intervention mean BMI 34.10 (5.50). Control mean age 57.40 years. Control mean BMI 33.50 (4.60). Ethnicity NR.	34.1	Regular advice from dietician and physiotherapist trained in MI. Group sessions involving cooking.	TAU.	Yes, both groups	Individual	Face-to-face	To investigate effect of weightloss competition and MI on development of Type 2 Diabetes, changes in BMI, dietary intake, and physical activity levels	1.1, 1.3, 2.2, 2.3, 3.1	NR.	Mean 37.2 months, 507 minutes (estimated)	NR	NR	NR	NR
Rodriguez-Cristobal (2017). Spain	864 adults (197 men, 667 women). Aged 30-70 years. BMI >25. Recruited through healthcare centres.	Cluster randomisation. Blinding NR.	Total sample mean age NR. Total sample mean BMI 34.10 (4.80). Intervention group mean age 57.69 (22.10) years. Intervention mean BMI 34.10 (4.80). Control mean age 55.49 (11.50) years. Control mean BMI 34.10 (4.80). Ethnicity NR.	34.1	Group motivational intervention discussing behaviour change, reinforcing reasons for change and maintaining changes, in addition to physiological assessments.	TAU including traditional lifestyle advice.	Yes, both groups	Group	Face-to-face	To assess change in bodyweight at 12 and 24 months compared to the control group.	1.1, 1.4, 2.6, 3.1, 5.1, 5.4, 9.2, 15.1	1.1	26 months, 1920 minutes.	NR	NR	3, 9, 13, 14, 20, 33, 35	Stages of Change
Saffari (2014). Iran	327 adults (0 men, 327 women). BMI 25-35, age >18 years. Recruited from primary care services.	Multi-stage random sampling. Blinding NR.	Total sample mean age NR. Total sample mean BMI NR. Intervention group mean age 33.99 (6.49) years. Intervention group mean BMI 35.11 (6.11). Control group mean age 34.62 (5.63) years. Control group mean	NR	Individual MI sessions about recognising emotions which may contribute to resistant behaviours. Discussion of pros and cons of behaviour change. Information about values of healthy behaviours and eating on health	Traditional lifestyle advice.	Yes, both groups	Individual	Face-to-face	To investigate the long-term impact of MI intervention on changes in dietary habit, bodyweight and metabolic markers.	1.4, 3.1, 5.1, 9.1, 9.2, 11.2	9.1	12 months; 300 minutes.	NR	NR	1, 3, 4, 9, 11, 35	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
			BMI 35.09 (5.29).		outcomes. Planning for future sessions included.												
Simpson (2015). UK	166 adults (26 men, 140 women). Age 18-70 years. BMI >30. Recruited through primary care practice databases and weightloss groups.	Remote telephone randomisation stratified by region, age, gender, ethnicity, source of recruitment, percentage weightloss to date and current BMI. Unblinded.	Total sample age 9.6% under 30, 60.8% 30-59 years, 29.5% over 60 years. Total sample 26 men (140 women). Total sample mean BMI 34.2 (5.9). Control sample age 10% under 30 years, 62.1% 30-59 years, 27.6% over 60 years. Control sample mean BMI 33.3 (5.2). Less intensive MI arm age 9.3% under 30, 61.1% 30-59 years, 29.6% over 60 years. Less intensive MI arm mean BMI 34.4 (6.2). Intensive MI arm age 9.3% under 30 years, 59.3% 30-59 years,	34.2	Individual MI sessions about challenges, self-monitoring, goal setting and implementation intentions, habits, emotional eating and relapse, diet, physical activity, barriers to maintenance, support and self-efficacy. Diaries provided but not reviewed by interventionist.	TAU and traditional lifestyle advice.	Yes, both groups	Individual	Face-to-face	To investigate effects on maintaining progress already made in weight loss.	1.1, 1.2, 1.4, 1.6, 2.3, 2.4, 3.1, 3.3, 5.1, 6.1, 8.3, 9.2, 10.3, 13.3	5.1	12 months; 180 minutes (intensive arm)	2 days MI training.	Audio recordings of face-to-face sessions analysed to assess fidelity. A random sample was assessed using MITI coding scale. A stratified sample included sessions delivered in the high and low intensity arms and by all practitioners. Skills in MI delivery were assessed prior to study entry via audio recorded mock consultations with patient actors. In order to be recruited, individuals were required to reach the MITI	2, 3, 4, 9, 17, 18, 21, 23, 32, 33, 34, 35, 36	Self-determination theory, cognitive dissonance theory, model of action phases, social cognitive theory,

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
			31.5% over 60 years.												proficiency threshold.		
Sun (2020). China	100 adults (sex NR). Age >18 years, <65 years, BMI >28, with sleep apnea. Recruited through hospital patients list from those who had received surgery.	Random number table used for randomisation. Blinding NR.	Mean age intervention group 43.54 (12.27) years. Mean age control group 39.95 (11.61) years. Ethnicity NR.	NR	routine education and MI.	Traditional lifestyle advice.	Yes, both groups	Individual	Face-to-face, telephone	To apply an MI intervention to postoperative weight control.	3.1, 4.1, 4.2, 5.1, 15.1	4.1	6 months; session duration NR.	NR	NR	NR	NR

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
West (2007). US	217 adults (0 men, 217 women). BMI >27. Recruited through social marketing channels, direct mail solicitation, and practitioner referrals.	Closed envelope randomisation. Interventionists and outcome assessors blinded.	Total sample mean age 53 (10) years. Total sample mean BMI 36.5 (5.5). Intervention sample mean age 54 (10) years. Intervention sample mean BMI 36.5 (5.5). Control sample mean age 52 (10) years. Control sample mean BMI 36.5 (5.4). 38% African American, 62% other.	36.5	group behavioural weight management program and then MI sessions covering motivating factors for weight loss and future goals.	BWLP	Yes, both groups	Individual	Face-to-face	To build and maintain motivation for weight loss.	1.1, 1.2, 1.6, 1.9, 2.2, 2.3, 3.1, 5.1, 8.7, 13.5	1.1, 1.2, 2.2, 2.3, 3.1, 3.7, 5.1, 8.7	12 months; 225 minutes.	NR	Ongoing clinical supervision and protocol fidelity monitoring. Randomly selected audio tapes reviewed weekly by 2 clinical psychologists using a standardized coding format.	1, 3, 13, 21, 22	NR
West (2011). US	338 adults (0 men, 338 women). Age >30 years, BMI 25-50, >10 episodes of urinary incontinence. Unclear how participants were recruited.	Cluster randomised within 18 study groups. Outcome assessors only blinded.	Total sample mean age 53 (10) years. Total sample mean BMI 36(6.0). 19% African American, 81% Other.	36	6-month behavioural weightloss program followed by group meetings delivered by dieticians, exercise physiologists, nurses and psychologists. Participants provided with self-monitoring diaries and weighed at each session. Motivation-focused maintenance program focused on increasing and sustaining motivation through eliciting personal motivation,	BWLP and group meetings only.	Yes, both groups	Group	Face-to-face	To evaluate a novel weight loss maintenance program specifically targeting motivational factors.	1.2, 1.3, 2.3, 3.1, 8.7, 13.1, 13.2, 13.5	1.2, 1.3, 2.3, 3.1, 8.7, 13.2	12 months; 1560 minutes.	"...explicit training of the intervention staff and ongoing supervision of treatment delivery."	Audiotapes of 10% sessions were reviewed by independent rater to assure protocol consistency, attention paid to inclusion of prescribed elements and exclusion of prohibited elements. Corrective feedback provided to intervention staff as necessary.	14, 17, 21	Rothman's Theory Based Analysis of Behavioural Maintenance, Self-Regulation Theory, Self-Identify Theory

Study	Population	Randomisation, blinding	Sample characteristics	Total sample mean BMI	Intervention	Comparator	General information provided?	Group, individual	Mode (face-to-face, telephone, online)	Aims	Intervention BCTs	Control BCTs	Dose (months/ minutes)	Reported training/ qualifications	Fidelity measure used?	Intervention MI techniques	Reported theoretical underpinning
					confirming progress, creating reinforcements.												
West (2016). US	398 adults (41 men, 357 women). Age >18 years, BMI 25-50. Recruited through community newspaper, flyers, fairs, targeted emails through mailing lists, word of mouth.	Randomisation stratified by baseline BMI percentile value, used biased coin approach. Blinding NR.	Total sample mean age 48.4 (10.1) years. Total sample mean BMI 36.0 (6.0). Intervention mean age 47.9 (9.5) years. Intervention mean BMI 35.9 (6.0). Control mean age 48.9 (10.7) years. Control mean BMI 36.1 (6.1). 24% African American, 76% Other.	36	18-month online group behavioural lifestyle program and 6 individual MI sessions using interactive, synchronous form of private chat integrated within a website used by group weight loss programme. Focussed on eliciting and elaborating change talk and identifying goals.	BWLP.	Yes, both groups	Individual	Online	To examine the addition of individual MI web chats to a group-based internet-delivered behavioural weight control program to weight loss outcomes compared to the behavioural weight control program alone.	1.2, 1.4, 2.3, 2.4, 3.1, 8.7, 12.5	1.2, 1.4, 2.3, 2.4, 3.1, 8.7, 12.5	18 months; 180 minutes.	Training from researcher.	Ongoing supervision from MINT trainer and psychologist. Transcripts reviewed and constructive feedback provided. Ongoing group telephone conversations.	1, 3,	NR

3.2. Quality assessment

Quality assessment is reported in the supplementary materials.. Risk of bias varied, but for the domains of random sequence generation (58.6%) and attrition (37.9%) a majority of studies were graded as low risk of bias. This was due to clearly described use of randomisation techniques or software (e.g., Huber et al., 2015) and participant drop-out was explained (e.g. Anderson et al., 2014). Around a third of papers were considered potentially at high risk of attrition bias due to lack of reporting about participant drop-out or handling of incomplete data (37.9%). For the domains of performance bias related to blinding of participants and staff (41.4%), detection bias related specifically to outcome assessor blinding (51.7%) and selective reporting bias (51.7%) a majority of studies had uncertain levels of risk. For example, in some cases (e.g. (Littman et al., 2019)) it was not clear who was blinded to allocation status, or if blinding of staff extended to outcome assessors. Intended outcomes were not always specified in advance meaning it was unclear if they were reported selectively. For nonrandomised studies, some risk of bias was present due to selection of participants to conditions and clarity of follow-up measure procedures, however follow-up durations and engagement data were clearly reported.

Table 5. Study outcomes

Study	Sample size (N randomised to relevant arms)	ITT?	Intervention duration	Measurement taken	*n* allocated	Baseline (Intervention) M(SD)	Post (Intervention) M(SD)	Intervention change score within group (SD)	n allocated	Baseline (Comparator) M(SD)	Post (Comparator) M(SD)	Comparator change score within group (SD)	Between groups effect size
BMI													
1 to 3 months follow-up													
Meybodi (2011)	30	N	NR	2 months	NR	30.61 (3.14)	NR	NR	NR	31.51 (3.70)	NR	NR	Follow-up scores NR.
DiMarco (2009)	39	Y	2.75 months	2.75 months	20	33.06 (3.17)	31.58 (3.08)	NR	19	31.62 (2.81)	30.92 (3.05)	NR	Cohen's d 0.21, 95%CI -0.56 to 0.99
Buscemi (2011)	70	Y	3 months	03 months	34	33.43 (4.88)	33.61 (4.70)	-0.04	36	32.26 (4.49)	32.56 (4.60)	-0.07	
4-6 months follow-up													
Befort (2008)	44	N	4 months	04 months	21	39.4 (7.1)	NR	-1 (1.5)	23	40.4 (5.8)	NR	-1.1 (2)	
Lewis (2019)	61	NR	4 months	04 months (crossover)	29	49.7 (NR)	NR	-1.74 (2.23)**	32	46.1 (NR)	NR	0.10 (2.3)**	
Braun (2018)	29	N	6 months	06 months	17	31.3 (5.50)	29.6 (5.36)	-1.7(2.10)**	12	32.6 (4.65)	31.5 (5.34)	-1.1(1.03)**	Cohen's d -0.35, 95%CI -1.10 to 0.39
Mirkarimi (2017)	100	N	2 weeks	06 months	50	28.25 (2.21)	26.53 (2.17)	NR	50	28.84 (1.59)	26.68 (2.53)	NR	Cohen's d -0.06, 95%CI -0.47 to 0.34
Moeller (2019)	37	N	6 months	06 months	19	Median 37.6 (35.2-48.1)	NR	Median 0.2 (-3.1-1.2)	18	Median 35.9 (33.9-38.8)	NR	Median -0.6 (-2.3-0.6)	Follow-up scores NR.

Study	Sample size (N randomised to relevant arms)	ITT?	Intervention duration	Measurement taken	*n* allocated	Baseline (Intervention) M(SD)	Post (Intervention) M(SD)	Intervention change score within group (SD)	n allocated	Baseline (Comparator) M(SD)	Post (Comparator) M(SD)	Comparator change score within group (SD)	Between groups effect size
Olson (2016)	472	Y	6 months	06 months	225	35.73 (12.33*)	35.00 (12.54*)	-0.73 (NR)	247	35.44 (12.76*)	35.75 (13.18*)	0.27 (NR)	Cohen's d -0.03, 95%CI -0.21 to 0.14
Sun (2020)	101	NR	6 months	06 months	50	33.72 (2.30)	31.94 (3.15)	NR		33.64(2.30)	33.88(2.45)	NR	
12 to 18 months follow-up													
Chee (2017)	173	Y	6 months	12 months	58	31.8 (6.85)*	29.5 (6.85)*	-2.3(3.05)*	115	29.6(4.3)*	29.5(4.3)*	-0.1 (2.14)*	
Barnes (2017)	59	Y	3 months	12 months	30	34.65 (7.06)	35.12 (2.02)	NR	23	35.07 (7.52)	34.55 (1.54)	NR	
Saffari (2014)	327	N	12 months	12 months	NR	35.11 (6.11)	31.05 (6.39)	-4.06 (NR)	NR	35.09 (5.29)	33.30 (5.26)	-1.79 (NR)	Cohen's d -0.69, 95%CI -0.92 to -0.46
Simpson (2015)	170	Y	12 months	12 months	55	34.40 (6.2)	33.3 (6.50)	-1 (-4.50)	58	33.3 (5.2)	33.0 (5.22)	NR	
Hardcastle (2013)	358	Y	3 months	15 months	203	33.66 (5.12)	33.68 (4.77)	NR	131	33.37 (4.47)	34.04 (4.88)	0.15 (1.14)	
West (2007)	217	N	12 months MI/18 months BWLP	18 months	109	36.5 (5.5)	NR	NR	108	36.5 (5.4)	NR	NR	

Study	Sample size (N randomised to relevant arms)	ITT?	Intervention duration	Measurement taken	*n* allocated	Baseline (Intervention) M(SD)	Post (Intervention) M(SD)	Intervention change score within group (SD)	n allocated	Baseline (Comparator) M(SD)	Post (Comparator) M(SD)	Comparator change score within group (SD)	Between groups effect size
West (2016)	398	Y	18 months	18 months	199	35.90 (6.00)	NR	NR	199	36.10 (6.10)	NR	NR	
24 months + follow-up													
Brautigam-Ewe (2020)	286	NR	24 months	24 months	113	31.6 (2.1)	31.2 (2.4)	NR	173	31.2 (1.9)	31 (2.7)	NR	
Penn (2009)	102	Y	5 years	60 months	51	34.1 (5.5)	NR	NR	51	33.5 (4.6)	NR	NR	Follow-up scores NR.
Karlsen (2013)	187	N	7-8 months	NR	110	35.6	NR	-1 (1.7)	77	34.9	NR	2.6 (NR)	Follow-up scores NR.
Weight (kg)													
2 to 6-month follow-up													
Buscemi (2011)	70	Y	3 months	03 months	34	92.01 (36.10)	92.34 (35.97)	NR	36	86.09 (30.98)	86.69 (31.30)	NR	
Low (2013)	56	Y	20 weeks	03 months	38	110.04 (40.8)	105.94 (2.9)	NR	18	105.14 (36.3)	103.64 (6.5)	NR	Cohen's d 0.50, 95%CI -0.35 to 1.35
Befort (2008)	44	N	4 months	04 months	21	103.7 (20.8)	NR	-2.6 (4.2)	23	109.6 (18.2)	NR	-3.2 (5.7)	
Lewis (2019)	61	NR	4 months	04 months (crossover)	29	138.4 (NR)	NR	-4.87 (6.61)**	32	126.1 (NR)	NR	0.38(6.81)**	Follow-up scores NR.
Littman (2019)	15	y	20 weeks	20 weeks	7	107.3 (16.2)	104.0 (18.1)	NR	8	104.6 (17.8)	106.4 (18)	NR	

Study	Sample size (N randomised to relevant arms)	ITT?	Intervention duration	Measurement taken	*n* allocated	Baseline (Intervention) M(SD)	Post (Intervention) M(SD)	Intervention change score within group (SD)	n allocated	Baseline (Comparator) M(SD)	Post (Comparator) M(SD)	Comparator change score within group (SD)	Between groups effect size
Braun (2018)	29	N	6 months	06 months	17	83.6 (15.78)	78.8 (14.89)	-4.8(5.63)**	12	87.60(17.20)	85.0(19)	-2.6(4.62)**	Cohen's d -0.37, 95%CI -1.12 to 0.37
Carels (2007)	55	Y	6 months	06 months	28	101.6 (22.5)	95.9 (24.5)	-5.8 (5.5)	27	96.6 (22.1)	92.8 (23.6)	-3.8 (4.9)	
Greaves (2008)	141	Y	6 months	06 months	72	91.6 (13.3)	91.3 (13.7)	NR	69	94.4 (14.2)	92.6 (15.00)	NR	
Huber (2015)	90	N	3 months	06 months	45	99.6 (14.0)	NR	-2.6 (4.4)	45	103.6 (18.9)	NR	-1.1 (3.7)	
Moss (2017)	135	N	3 months	06 months	69	95.11 (21.45)	91.32 (20.78)	NR	66	90.34 (19.46)	85.77(16.65)	NR	
Moeller (2019)	37	N	6 months	06 months	19	Median 108.6 (96.5-124)	NR	Median 0.4 (-8.9-3.5)	18	Median 106.1 (97.8-113.9)	NR	Median -1.7 (-6.6-1.6)	Follow-up scores NR.
Sun (2020)	100	NR	6 months	06 months	50	84.13 (14.98)	79.80 (12.62)	NR	50	85.81 (13.13)	85.33(12.94)	NR	
Olson (2016)	472	Y	6 months	06 months	225	107.88 (40.39*)	105.52 (41.67*)	-2.36 (NR)	247	106.40 (41.67*)	107.35 (42.52*)	0.95 (NR)	Cohen's d -0.04, 95%CI -0.22 to 0.14
12 to 18-month follow-up													
Anderson (2014)	329	Y	12 months	12 months	163	90.2 (14.9)	87.2 (15.7)	-3.5 (4.91)	166	88.4 (14.3)	88.1 (14.2)	-0.78 (3.77)	

Study	Sample size (N randomised to relevant arms)	ITT?	Intervention duration	Measurement taken	*n* allocated	Baseline (Intervention) M(SD)	Post (Intervention) M(SD)	Intervention change score within group (SD)	n allocated	Baseline (Comparator) M(SD)	Post (Comparator) M(SD)	Comparator change score within group (SD)	Between groups effect size
Groeneveld (2010)	816	N	12 months	12 months	408	93.1 (13.2)	92.2 (13.7)	-0.9 (NR)	408	92.0 (12.80)	92.9 (13.6)	0.9 (NR)	Cohen's d -0.05, 95%CI -0.18 to 0.09
Barnes (2017)	59	Y	3 months	12 months	30	87.99 (54.27)	99.49 (12.85)	1.49 (12.9)	29	99.50 (53.88)	98.11 (9.24)	-1.4 (8.2)	
Chee (2017)	173	Y	6 months	12 months	58	82.8 (19.80)*	75.9 (19.03)*	-6.9(9.90)*	115	78.1 (13.94)*	77.3 (15.01)*	-0.8(5.36)*	
Saffari (2014)	327	N	12 months	12 months	NR	80.96 (15.00)	77.82 (14.94)	-3.14 (NR)	NR	81.77 (9.86)	80.35 (9.93)	-1.42 (NR)	Cohen's d -0.69, 95%CI -0.92 to -0.46
Hardcastle (2013)	358	Y	3 months	15 months	203	93.64 (15.93)	94.12 (15.66)	NR	131	91.38 (16.88)	92.75 (17.37)	0.12 (1.37)	
West (2007)	217	N	12 months (MI) 18 months BWLP	18 months	109	97 (17)	NR	-3.5 (8.8*)	108	97 (15)	NR	-1.7 (8.9*)	
West (2011)	338	N	6 months	18 months	113	NR	NR	-5.34 (8.32**)	113	NR	NR	-1.38 (6.58**)	Follow-up scores NR.
West (2016)	398	Y	18 months	18 months	199	98.40 (19.00)	NR	-3.5 (7.7)	199	98.20 (18.40)	NR	-3.3 (7.1)	
24 months + follow-up													

Study	Sample size (N randomised to relevant arms)	ITT?	Intervention duration	Measurement taken	*n* allocated	Baseline (Intervention) M(SD)	Post (Intervention) M(SD)	Intervention change score within group (SD)	n allocated	Baseline (Comparator) M(SD)	Post (Comparator) M(SD)	Comparator change score within group (SD)	Between groups effect size
Brautigam-Ewe (2020)	286	N	24 months	24 months	113	89.5 (11.3)	88.4 (11.5)	NR	173	88.9 (12.3)	88(12.3)	NR	
Rodriguez-Cristobal (2017)	864	N	7.35 months	24 months	402	85.50 (13.87*)	83.20 (15.55*)	2.5 (9.26*)	447	87.10 (14.48*)	84.90 (13.04*)	1 (5.64*)	Cohen's d 0.11, 95%CI -0.31 to 0.07
Penn (2009)	102	Y	5 years	60 months	51	93.4 (16.0)	91.10 (SD NR)	-2.3 (NR)	51	90.6 (12.5)	NR	0.01 (NR)	SD NR.
Karlsen (2013)	187	N	7-8 months	NR	110	100	90.7	-1 (1.7)	77	97	92.7	-0.4 (1.3)	SD NR.
% weight loss													
LaRose (2020)	47	Y		03 months	24	NR	NR	-3.3(3.8)%	23	NR	NR	-2.2(4.1)%	Follow-up scores NR.

* calculated from SE

** calculated from CI

NR = not reported.

Effect size calculated as $M_1 – M_2$ / pooled SD.

21

3.3. Behavioural outcomes

In addition to investigating bodyweight outcomes, 96.7% also examined behavioural outcomes such as physical activity, dietary intake, adherence, motivation or self-efficacy and related constructs or sleep quality. Within 15 papers reporting outcomes of PA, 26.7% (Anderson et al., 2014; Carels et al., 2007; Chee et al., 2017; Olson et al., 2016) reported a significant improvement within the intervention group. For dietary intake, 53.3% (Anderson et al., 2014; Braun et al., 2018; Bräutigam-Ewe et al., 2020; Chee et al., 2017; Hardcastle et al., 2013; Lewis et al., 2011; Olson et al., 2016; Saffari et al., 2014) of 15 papers reported improvements within the intervention group. Motivation appeared to decrease over time for all participants (Barnes et al., 2017, p. 201) whilst stages of change and self-efficacy measurements had no significant changes for one study (Buscemi et al., 2011) and appeared to increase over time in the intervention group for others (Huber et al., 2015; Lewis et al., 2019; Low et al., 2013; Meybodi et al., 2011; Mirkarimi et al., 2017). Table 6 reports findings of non-bodyweight outcomes.

Table 6. Study outcomes (behavioural)

Study name	Measure	Intervention duration	Timepoints reported	Findings
Anderson (2014) UK	Physical activity (SenseWear armband); Dietary intake (questionnaire)	12 months	0 months; 3 months; 12 months.	Intervention group spent more time active, consumed more fruit and vegetables and less fat than the comparator group. No difference for other nutritional intakes or alcohol use, but higher % of the intervention group reduced weekday alcohol consumption.
Barnes (2017) US	Motivation (Autonomous Motivation subscale of the TSRQ); Disordered eating symptomology (EDE-Q);Depression symptomology (BDI)	12 weeks	0 months; 15 months.	No significant changes in depressive symptomology. Significant decreases in motivation for all participants (p=.008). Significant decrease in disordered eating symptomology for all participants (p<.005).
Befort (2008) US	Adherence (number of sessions);Adherence (number of self-monitoring logs returned);Dietary intake (24-hour	16 weeks	0 weeks; 16 weeks.	No significant difference in adherence between groups. Both groups significantly decreased kcal daily intake and fat intake (p=.001). Both groups significantly

Study name	Measure	Intervention duration	Timepoints reported	Findings
	recall);Physical activity (CHAMPS), Self-efficacy (Questionnaire)			increased number of fruit and vegetable servings (p=.007) and decreased fat intake (p=.006). No effect on physical activity. Motivation (p=.001) and exercise self-efficacy (p=.01) was significantly reduced for both groups over time but there were no effects of condition.
Braun (2018) US	Dietary intake (FFQ, HEI);General self-efficacy; Physical activity (step count)	6 months	0 weeks; 6 months.	MI participants experienced significant improvements in HEI (p=.02), and a nonsignificant trend of improvements was seen for non-MI (p=.15). Increases in general self-efficacy for the intervention group (p=.08), not for the comparator group (p=.84). No significant difference between groups (p=.16).No significant changes for either MI (p=.40) nor non-MI group (p=.32) and no significant differences between groups (p=.63).
Bräutigam-Ewe (2020) Sweden	Quality of life (EuroQOL 5);Dietary intake (fruit/vegetable intake)	2 years	0 months; 24 months.	Improvements in anxiety/depression scores in the intervention group. Significant difference between groups at 2 years for anxiety/depression (p=.013), usual activities (p=.004), pain/discomfort (p=.041). Significantly higher fruit and vegetables intake in the MI group at follow-up (p=.005).
Buscemi (2011). US	Physical activity (one-month recall);Dietary intake (FFQ); Stages of Change (Contemplation Ladder)	2 weeks	0 weeks; 12 weeks.	Condition did not significantly predict moderate exercise (p=.56), vigorous exercise (p=.80), fast food consumption (p=.07), sweetened drink intake (p=.12), fruit intake (p=.40) or vegetable intake (p=.20). Moderate (d=.56, d=.50) effects on motivation to change weight and activity, and large effect (d=.75) on motivation to change diet. This did not predict actual change at 3 months.
Carels (2007). US	Physical activity (daily diary);Dietary intake (96-hour recall)	24 weeks	0 weeks; 24 weeks.	Intervention participants engaged in significantly more physical activity at

Study name	Measure	Intervention duration	Timepoints reported	Findings
				followup (p=.05, d=.60). No effects on dietary intake.
Chee (2017). Malaysia	Dietary intake (72-hour recall);Physical activity (IPAQ-SF)	6 months	0 months; 3 months; 6 months; 9 months; 12 months.	MI group energy intake significantly reduced overall (p<.001) and activity duration significantly increased (p<.001).
DiMarco (2009). US	Depression symptomology (BDI);Quality of life/life satisfaction (Q-LES-Q-SF);Eating behaviour (EDE-Q,TEFQ)	11 weeks	0 weeks; 11 weeks.	Intervention group scored significantly lower on the disinhibition scale of EDE-Q (p=.02), but no significant effect of time. No significant effects of treatment group on any other variables. Significant decreases in EDE-Q restraint over time (p=.01), shape concern (p=.01), increases in flexible control (p=.01), and rigid control (p<.001).
Greaves (2008). UK	Physical activity (proportion reaching target activity level).	24 weeks	0 weeks; 24 weeks.	No significant difference in physical activity targets reached.
Groeneveld (2010). Netherlands	NR	24 weeks	0 weeks; 24 weeks	NR
Hardcastle (2013). UK	Physical activity (IPAQ, walking);Stages of change for physical activity (flowchart); Dietary intake (DINE, FACET).	6 months	3 months; 6 months; 18 months.	Intervention group significantly increased physical activity (walking) between baseline and 6 months (p=.006, d=.24) and baseline and 18 months (p=.032, d=.20) but no significant differences between groups over time. Stages of change showed significant increases between baseline and 6 months (p<.001, d=.29) and significant decreases from 6 to 18 months (p<.001, d=.29) for MI group. Decrease in fat intake for MI group (p<.001, d=.43) between baseline and 6 months, which was maintained to 18 months (p<.001, d=.38).
Huber (2015). US	Physical activity (IPAQ 7-day recall);Dietary intake (FFQ questionnaire);Self-efficacy (WEL questionnaire)	12 weeks	0 weeks; 6 weeks; 12 weeks; 18 weeks; 24 weeks.	No significant differences in physical activity, dietary intake, or theory-based measures between groups. Significantly greater change from baseline in the intervention group for self-efficacy (p=.07), and re-structuring plans (p=.006)

Study name	Measure	Intervention duration	Timepoints reported	Findings
Karlsen (2013). Denmark	NR	NR	NR	NR
LaRose (2020). US	Autonomous self-regulation (TSRQ);Autonomy support (HCCQ)	3 months	0 months; 3 months.	Modest increases in autonomous self-regulation observed in both groups over time, but no significant differences by condition (p=.83). Reductions in controlled motivation observed, no significant differences between groups (p=.56). Perception of autonomy support at post-treatment higher in MI group (p=.08, d = .77).
Lewis (2019). Australia	Dietary intake (FFBQ);Physical activity (energy expenditure, step count);Weight self-efficacy (WEL-SF);Exercise self-efficacy (PAII);Treatment self-regulation (TSRQ) for diet and exercise.	4 months (cross-over trial)	0 months; 4 months; 8 months.	A significant interaction between time and condition (p=.002) for dietary intake with a mean change of 0.06 for intervention. Significant interaction for time and condition (p=.02) for physical activity step counts, indicating significant increases in steps for the intervention group at 4 months which was not maintained to 8 months. Control-MI group did not significantly change step counts in the first 4 months but significantly increased between 4 and 8 months. Significant interaction effects for weight and exercise self-efficacy (p<.001, p<.001). Both groups improved weight self-efficacy further when receiving the MI support component of the trial. No significant interaction effects for diet or exercise self-efficacy (p=.11, p=.51).
Littman (2019). US	Physical activity (sedentary time; decisional balance);Diet quality (dietary recall)	20 weeks	0 months; 20 months.	Changes over time between groups were not significantly different for 'get up and go' tasks (p=.23). No significant difference in step counts over time between groups (p=.39). No significant difference in changes over time for sedentary behaviour (p=.63), nor decisional balance of pros (pp=.39) and cons (p=.39), nor of diet quality changes over time (p=.45). Depression scores and quality of life NR.

Study name	Measure	Intervention duration	Timepoints reported	Findings
Low (2012). US	Stages of change (Weight Loss Stages of Change Questionnaire);Quality of life (OWQOL-LITE);Mood; physical activity; self-efficacy (questionnaire NR).	3 months	0 weeks; 3 months.	No significant differences in quality of life between groups over time. Self-efficacy ratings increased only in the intervention group. Readiness to change showed increases over time.
Meybodi (2011). Iran	Self-efficacy (WEL)	4 weeks	0 weeks; 12 weeks.	Participants in the intervention group significantly improved their self-efficacy from pre to post intervention. Intervention group had significantly greater scores for negative emotions, social pressures, physical discomfort and positive activities than the comparator. Significant effect of condition (p=.001) overall and on negative emotion (p=.024), social pressure (p=.040) physical discomfort (p=.006) and positive activities (p=.017), indicating higher scores in the intervention group.
Mirkarimi (2017). Iran	Self-efficacy (WEL)	2 weeks	0 weeks; 2 months; 6 months.	MI group scored significantly higher on self-efficacy, social pressures, food availability, physical discomfort, negative emotions, and positive activities than the comparator.
Moeller (2020). Denmark	Wellbeing (WHO-5)	6 months	0 months; 6 months.	No significant differences between groups at baseline or follow-up. Pooled data from all participants showed improvements in wellbeing over time (p=.028).
Moss (2017). Canada	Adherence (number of sessions);Readiness to change (questionnaire)	12 weeks	0 weeks; 36 weeks.	No significant differences in adherence between groups. No significant differences for confidence for change, importance and readiness.
Olson (2016). US	Dietary intake(recall questionnaire);Physical activity (HPAS);Sleep (PSQI)	24 weeks	0 weeks; 24 weeks.	Significant increase in fruit and vegetable servings and physical activity levels for the intervention group (p=.005). Increases in sleep quality but no significant difference between groups. No significant interaction effect on number of days with 30 mins physical activity.

Study name	Measure	Intervention duration	Timepoints reported	Findings
Penn (2009). UK	Health status (questionnaire);Dietary intake (72-hour recall);Physical activity (72-hour recall)	52 weeks	0 weeks; annually until endpoint.	No significant difference between groups at any year.
Rodriguez-Cristobal (2017). Spain	Smoking (number of packets/year)	24 months	0 weeks; 52 weeks; 104 weeks.	NR
Saffari (2014). Iran	Dietary intake (FFQ)	52 weeks	0 weeks; 52 weeks	Significant increase in whole grain, fibre, fish, fruit, and vegetable intake for the intervention group (p<.05).
Simpson (2015). UK	Dietary intake (DINE);Physical activity (IPAQ);Quality of life (EQ-5D);Binge eating symptomology (EDE-Q);Wellbeing (GHQ-9);Adherence (attendance)	52 weeks	0 weeks; 24 weeks;	Dietary intake (DINE) showed adjusted mean difference 0.5 greater for the intensive compared to control arm (95%CI -3.2 to 4.1). Physical activity (IPAQ) was not impacted by treatment group ;Quality of life (EQ-5D);Binge eating symptomology (EDE-Q) was not assessed using inferential analysis; Wellbeing (GHQ-9) odds of scoring 3 and above was 12% higher for those in the intensive compared to control arm (OR 1.12, 95%CI 0.4 to 3.09). The EQ-5D questions appeared that the odds of scoring 100 was 15% lower in the intensive compared to control arm (0.85, 95%CI 0.29 to 2.46) ;Adherence (attendance) identified that those in the control group were least likely to actively withdraw and only 10% overall withdrew from the study
Sun (2020). China	Sleep (SRSS; EPS)	6 months	0 months; 6 months.	Sleep improved for participants in the intervention group significantly more compared to the control group (p<.005).
West (2007). US	Adherence (attendance at sessions, number of self-monitoring diaries submitted);Diary quality	52 weeks	0 weeks; 24 weeks; 52 weeks; 76 weeks.	No evidence of differences in attendance between groups at MI sessions or BWLP. MI group submitted more diaries.

Study name	Measure	Intervention duration	Timepoints reported	Findings
West (2011). US	Adherence (attendance at sessions);Adherence (number of self-monitoring diaries submitted)	24 weeks	0 weeks; 24 weeks; 76 weeks.	Attendance greater for comparator group than intervention group. Intervention group submitted fewer self-monitoring diaries.
West (2016). US	Adherence (session attendance).	76 weeks.	0 weeks; 24 weeks; 76 weeks.	Engagement declined over time, with an average of 31% attendance in the intervention group following the initial 6 months.

12 studies were eligible for inclusion within the standardised mean difference (SMD) meta-analysis of final measurements of BMI and kilogram outcome measures. Change scores and final measurement scores cannot be combined within SMD meta-analysis as the standard deviations are representing different things (Higgins, 2011). However, 7 studies were eligible for inclusion within separate BMI analyses and 15 within separate kilogram outcome analyses.

3.4. Effect of MI on pooled adiposity outcomes (BMI and bodyweight final measurements).

Overall, 1683 participants took part in 12 studies (Anderson et al., 2014; Barnes et al., 2017; Bräutigam-Ewe et al., 2020; Buscemi et al., 2011; Carels et al., 2007; Chee et al., 2017; Greaves et al., 2008; Hardcastle et al., 2013; Littman et al., 2019; Moss et al., 2017; Simpson et al., 2015; Sun et al., 2020) reporting final measurement values for BMI and KG with a total sample baseline BMI of >30 kg/m^2. Where possible, final measurement BMI was extracted for inclusion; for several papers only bodyweight in kilograms was reported (Anderson et al., 2014; Carels et al., 2007; Greaves et al., 2008; Littman et al., 2019; Moss et al., 2017) and thus the final bodyweight in kilograms was utilised for the pooled outcome analysis. Using a random-effects meta-analysis, the standardised mean difference (SMD) of the effect on BMI and KG final measurement outcomes was -0.01 (95%CI -0.13 to 0.12, p=.93), indicating no significant effect of MI on the pooled final measurement outcomes. See Figure 3 for forest plot providing meta-analysis with 95%CI.

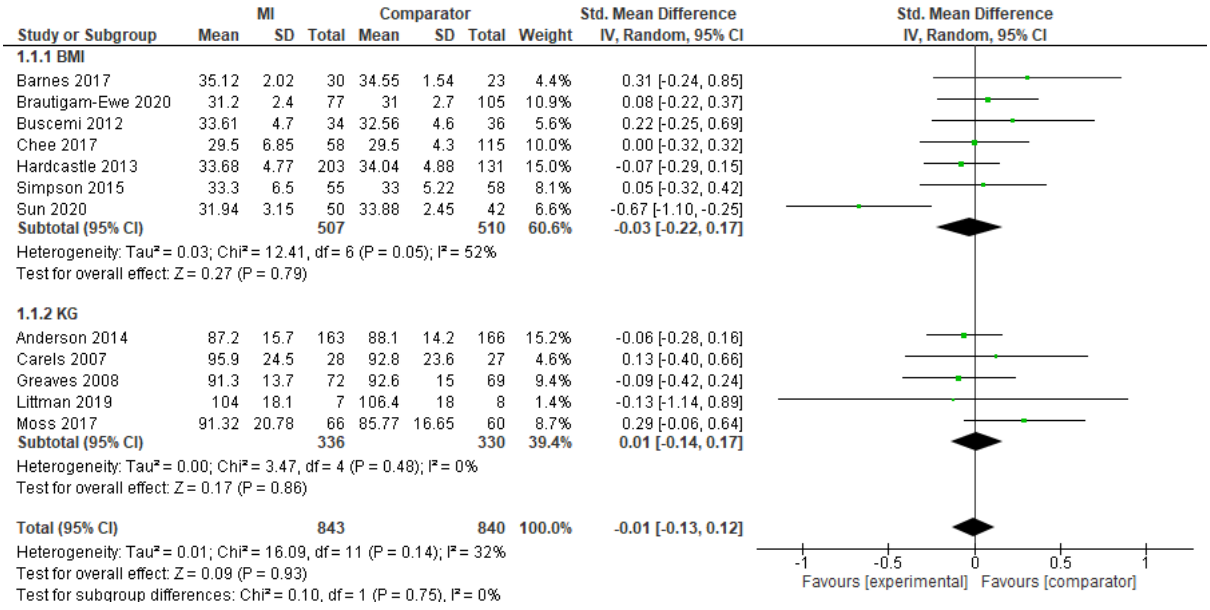

Figure 3. Forest plot representing the effect of MI on pooled adiposity outcomes (BMI and bodyweight final measurements)

The primary reason for exclusion of randomised trials from the SMD meta-analysis was that only change scores were reported. To check publication bias, the funnel plot (see Figure 4) was visually examined for asymmetry and indicated that there may be small study publication bias. Potential sources of bias may result from selective reporting of results, or inclusion of studies with small sample sizes.

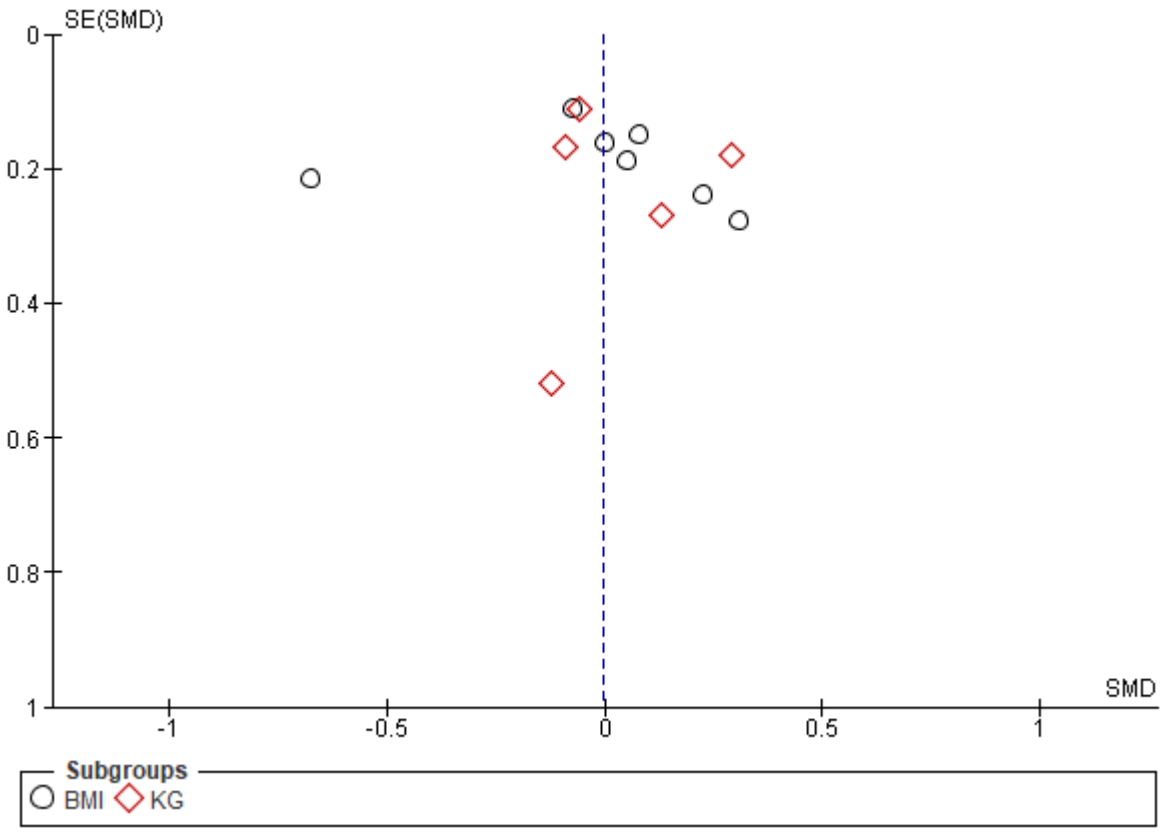

Figure 4. Funnel plot indicating potential small study bias

3.5. Effect of MI on bodyweight outcomes (kilograms).

Additionally, 15 papers (Anderson et al., 2014; Barnes et al., 2017; Befort et al., 2008; Bräutigam-Ewe et al., 2020; Buscemi et al., 2011; Carels et al., 2007; Chee et al., 2017; Greaves et al., 2008; Hardcastle et al., 2013; Huber et al., 2015; Littman et al., 2019; Moss et al., 2017; Smith West et al., 2007; Sun et al., 2020; West et al., 2016) reporting bodyweight outcomes in kilograms in final measurements or change scores in KG were analysed using a random-effects meta-analysis. Several papers (Befort et al., 2008; Huber et al., 2015; Smith West et al., 2007; West et al., 2016) were eligible for inclusion within this analysis that were not included in the pooled outcome analysis. Results indicated no significant effect of MI on bodyweight (kilograms) outcomes, with a mean difference (MD) of -0.52 KG between loss in the intervention compared to the comparator group (95%CI -1.34 to 0.31, p=.22). See Figure 5 for forest plot presenting data with 95%CI.

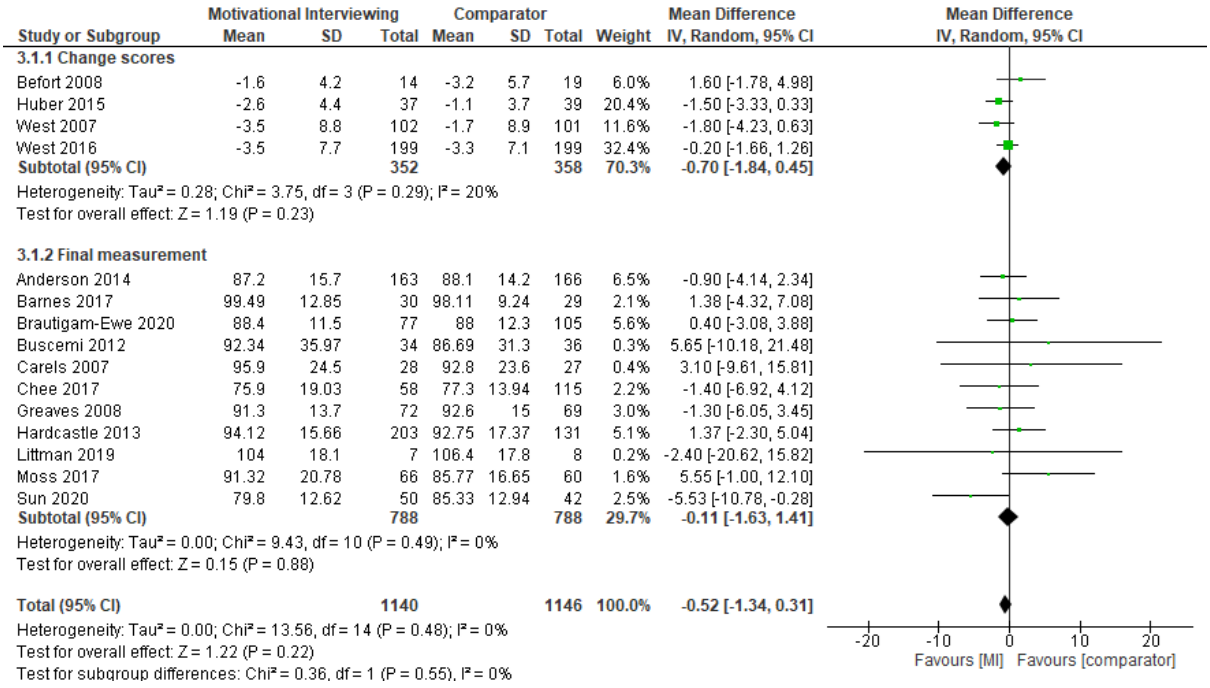

Figure 5. Forest plot representing the effect of MI on bodyweight (KG) final measurement and change score adiposity outcomes

3.6. Effect of Motivational Interviewing on BMI outcomes.

Further, 8 papers (Barnes et al., 2017; Befort et al., 2008; Bräutigam-Ewe et al., 2020; Buscemi et al., 2011; Chee et al., 2017; Hardcastle et al., 2013; Simpson et al., 2015; Sun et al., 2020) reporting BMI change scores and final measurements were analysed using random-effects meta-analysis; this indicated no evidence of a statistically significant effect of MI on BMI outcomes (MD = -0.10, 95%CI -0.73 to 0.53, p=.76). See Figure 6 for forest plot with 95%CI.

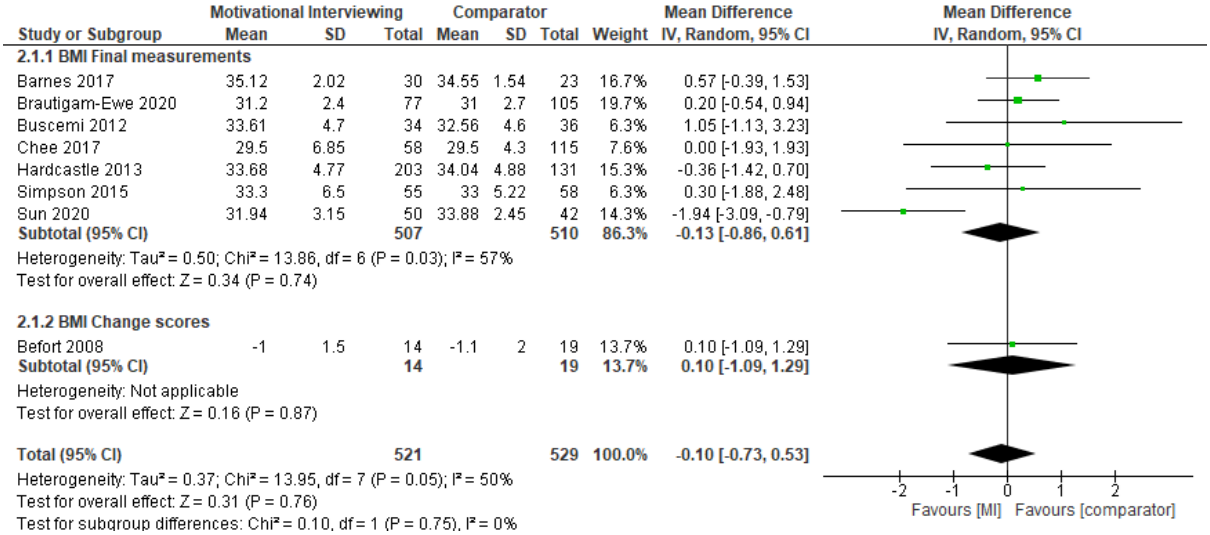

Figure 6. Forest plot representing the effect of MI on BMI final measurement and change score adiposity outcomes

4. Discussion

This review aimed to evaluate the effectiveness of MI for weight loss and report the methodology and content of interventions; including theoretical underpinnings and identification of behaviour change (BCTs) and MI techniques. No evidence of significant overall effects was identified. Findings suggested that similar BCTs were present in both conditions, indicating possible treatment contamination if arms did not differ sufficiently (Torgerson, 2001). Future research could more clearly report the content of control conditions and practitioner approach, particularly when relational elements of MI may be an influential factor of effectiveness (Hardcastle et al., 2017). Work investigating participant experiences (Hardcastle & Hagger, 2011) involved in one included trial (Hardcastle et al., 2013) identified themes of monitoring and support and listening support. Specifically, participants reported that contact with, and health checks from practitioners incentivised adherence to lifestyle changes. It may be possible in other research that the control group's treatment as usual or active comparator offered a form of maintained contact and support in behaviour change from practitioners who may have delivered this in an MI-adherent manner. Without clearer understanding of comparator and delivery routes it is difficult to disconfirm that these relational components were not vital to the behaviour change. Potential overlap in what was delivered to participants within studies should be a consideration for interpretation, and future research could closely consider the interpersonal style of comparator delivery within trials.

To further understanding of what mechanisms may be utilised to support the intended behaviour change, reported methods were systematically considered. 'Social support – unspecified' (3.1) was the most frequently identified intervention code (see Supplementary materials https://onlinelibrary.wiley.com/doi/10.1111/cob.12457). Within the BCT taxonomy, MI is coded under 'social support – unspecified' (3.1) which may not accurately represent the complexity of components (Hardcastle et al., 2017). When this code is discounted, more than half (58.94%) of all identified BCTs were in the goals and planning and feedback and monitoring categories. Some items from the MI-specific taxonomy overlap with BCTs. For example, discussion of the pros and cons of behaviour

change was coded as 9.2 within the BCTTv1 (Michie et al., 2013), and within the MI taxonomy as 'running head start.' Prevalence rates for such items from the two taxonomies were similar, supporting that MI techniques identified by Hardcastle and colleagues are a viable tool for examination of MI-specific components. Whilst no MI techniques have defined overlap with the feedback and monitoring group of BCTs, 30.7% of identified MI techniques in intervention descriptions had specific overlap with BCTs from the goals and planning group. This supports that a goal of MI, to make plans for change actions, utilises specific techniques. No MI techniques were identified within comparator arms. MI techniques may be more accurately identified within audio transcriptions of sessions than brief study descriptions. The BCTTv1 identified similar techniques present within intervention and comparator content that the MI techniques did not. However, fewer BCTs were coded for the control conditions. Without access to in-depth content, it is possible that utilised techniques were coded as absent due to limited information available. Meta-regression of techniques may provide further contextualised information regarding predictive elements of effective behaviour change interventions but was outside of the current scope (Samdal et al., 2017).

In comparison to earlier work, meta-analysis did not find evidence of significant difference between final physiological measurements of MI and non-MI group participants. Armstrong and colleagues (Armstrong et al., 2011) identified studies with a BMI $\geq$25 kg/m^2 and without additional intervention components, and completed a meta-analysis identifying significant effects. This was in terms of an increased bodyweight reduction compared to a control group of -1.47KG. We identified 6 papers which overlapped with Armstrong's review (Befort et al., 2008; Carels et al., 2007; DiMarco et al., 2009; Greaves et al., 2008; Hardcastle et al., 2008; Smith West et al., 2007) and 21 papers published since 2011. Similarly to current findings, no statistically significant effect of MI on bodyweight outcomes within a pooled analysis of BMI specific outcomes was found. One consideration when conducting obesity-specific research is that BMI fails to determine adiposity from muscle and bone (Burkhauser & Cawley, 2008). However, BMI is generally considered an adequate indicator and it is frequently used to determine obesity cut-offs (Nuttall, 2015). In the current review BMI was an appropriate outcome measure due to the frequency of use which permitted data synthesis

in the meta-analysis, however future research should consider reporting other measurements such as waist circumference (NHS Digital, 2016).

MI centres upon resolving ambivalence for behaviour change, whilst promoting autonomy and building motivation (Miller & Rollnick, 2013). As these targets map more closely to behavioural than physiological outcomes, it is plausible that whilst effects on bodyweight outcomes were inconclusive, interventions may have influenced behavioural factors such as physical activity (PA) and diet. Half of the trials measuring diet-related outcomes reported beneficial effects of MI, and around a quarter reported beneficial effects for physical activity related outcomes in comparison to the non-MI group. There may be beneficial effects of MI interventions for behavioural outcomes such as eating behaviours (Anderson et al., 2014; Braun et al., 2018; Bräutigam-Ewe et al., 2020; Chee et al., 2017; Hardcastle et al., 2013; Lewis et al., 2019; Olson et al., 2016; Saffari et al., 2014) and physical activity(Anderson et al., 2014; Carels et al., 2007; Chee et al., 2017; Hardcastle et al., 2013; Olson et al., 2016), and future investigations should assess the impact of MI for such outcomes. In a prior systematic review[6] there was found to be no significant change in behavioural outcomes for the intervention group in comparison to the control group. Conversely, Knight and colleagues (Knight et al., 2006) found that MI appeared to have beneficial effects for a range of health outcomes including psychological (e.g. readiness to change), physical (e.g. bodyweight and metabolic control) and lifestyle changes (e.g. exercise and alcohol intake), but issues in study quality prevented meta-analysis. Mixed findings point towards a need for further study into the effects of MI on behavioural outcomes and motivation measurements.

Whilst use of methods such as online and telephone contact can improve accessibility, heterogeneity in methods can limit comparability. Miller & Rollnick (Miller & Rollnick, 2013) have highlighted the importance of the spirit of MI, which is its client-centred focus, which may not be reported within intervention descriptions or technique taxonomies (Hardcastle et al., 2017). Use of fidelity measures can assist in confirming the practitioner is adhering to the spirit (Armstrong et al., 2011; Barnes & Ivezaj, 2015). Within papers reporting fidelity measures, it is not always clear if there were implications for sessions not utilising a MI-consistent approach. Miller & Rollnick (Miller &

Rollnick, 2014) have recommended utilising quality assurance methods initially to ensure interventionist proficiency and avoiding feedback to correct practice, in order to mirror real-life settings of behavioural interventions. Understanding of interventionist background and the content of sessions being delivered is necessary for the design of replicable interventions and can be aided by use of tools such as the template for intervention design and replication (TiDIER) (Hoffmann et al., 2014). Similarly, this may support avoidance of content overlap between the control and intervention. However, within the current review, there was no stated use of these of reporting templates. Multiple reviews over the past decade have highlighted the lack of reporting of fidelity and training as an issue within the field (Armstrong et al., 2011; Barnes & Ivezaj, 2015; Patel et al., 2019).

There are important limitations to consider. Searches were limited to material accessible in English language; this may exclude relevant papers and lead to location bias. However, 12 studies (Bräutigam-Ewe et al., 2020; Chee et al., 2017; Karlsen et al., 2013; Lewis et al., 2019; Meybodi et al., 2011; Mirkarimi et al., 2017; Moeller et al., 2019; Moss et al., 2017; Rodriguez-Cristobal et al., 2017; Sun et al., 2020) were identified that were based outside of the US and UK. Use of final measurement score over time is less ideal for inclusion within meta-analysis than use of change scores, but this was dependent on outcomes published in the articles. Inaccessibility of data meant some articles were not included within meta-analyses, which may skew findings. Studies may have been underpowered to identify true effects. Although findings should be interpreted with care, there are key strengths to the current review. It has built upon the existing evidence-base in a number of ways including: (1) the identification of articles not included in previous reviews, (2) inclusion of trials that used novel intervention formats, and (3) meta-analysis of study data. Additionally, use of technique taxonomies furthers understanding of what is involved within session content, and can support further research in identifying effective interventions.

To conclude, this review identified that a range of methodologies of MI have been researched for effectiveness of weight loss outcomes, and a meta-analysis found no significant overall effect. However, no significant increases in weight comparable to the comparator groups were observed. Frequently reported BCTs included social support, self-monitoring of behaviour, problem solving,

goal setting and information about health consequences, which is consistent with current recommendations from government bodies such as Public Health England (Public Health England, 2017), and demonstrates integration of MI with these techniques. The novel use of recently itemised MI techniques (Hardcastle et al., 2017) was a feasible method for coding descriptions and identified overlap with an existing BCT taxonomy. It is possible, but unsupported by the current evidence-base, that MI is a beneficial approach within overweight and obesity settings, and thus further research should address the methodological problems identified by this review and seek to confirm the most likely mechanisms of action related to this complex intervention.

Chapter 4. What makes Motivational Interviewing effective in changing health-related behaviour? A qualitative investigation of healthcare professionals' experiences and perspectives.

Foreword

The findings of the systematic review and meta-analysis were that Motivational Interviewing (MI) may potentially be an effective intervention for adiposity-related health outcomes. However, due to limited reporting of intervention content and the elements of MI used in practice, it was unclear which components of the intervention may explain its effectiveness. Therefore, the present chapter reports the findings of a qualitative research study designed to establish the perspectives of healthcare professionals who worked within behaviour change. This would inform potential theoretical mechanisms of MI and the elements of interest for future research studies.

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Title

What makes Motivational Interviewing effective in changing health-related behaviour? A qualitative investigation of healthcare professionals' experiences and perspectives.

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Abstract

Objective

Motivational Interviewing (MI) is an approach to communication that utilises empathy, collaboration and a guiding style to support someone in resolving ambivalence and preparing to change behaviours. The active components as applied in practice, however, are less well understood. We therefore explored healthcare practitioner experiences and perspectives about how MI facilitates health-related behaviour change in practice settings.

Methods

A qualitative design was used with semi-structured interviews with 14 healthcare professionals with experience of receiving MI training and working with patients working across weight management, primary care, health promotion, counselling and clinical psychology settings conducted to understand how MI is applied to behaviour change conversations and how they perceived it to support change. Data were digitally audio-recorded, transcribed verbatim and analysed using inductive thematic analysis.

Results/conclusion

Five themes were identified by thematic analysis including (1) Building competence in MI, (2) Integrating MI into practice, (3) When to use MI, and when not to, (4) Impact of the external environment, and (5) Enabling a deep understanding of the person and their strengths. Practitioners considered MI as an appropriate method of offering individualised support for behaviour change that allowed them to work in collaboration with their patients.

Practice implications

Consideration of interpersonal factors in particular was deemed crucial in enabling meaningful health-related behaviour change. The relational hypothesis of MI is therefore an opportunity for research into specific mechanisms of action of the approach. Practitioners valued opportunities for developing MI competence through training and reflection to enhance effectiveness.

1. Introduction

Practitioners working in healthcare settings are often required to facilitate behaviour change with their patient groups for beneficial health outcomes, for example supporting changes to physical activity or eating behaviours (National Institute for Health and Social Care Excellence, 2014). One such approach to having conversations about change is Motivational Interviewing (*MI*; (Miller & Rollnick, 2013). MI is a directive communication approach which intends to facilitate changes through resolving ambivalence about making the change and developing a plan for action. It involves four processes related to building *engagement* with the patient, *focusing* on specific behaviours, *evoking* the reasons for changing specific behaviours, and *planning* for actions to take (Miller & Rollnick, 2013). The practitioner using MI embraces a guiding style to discuss the patient's viewpoints on the desired change, whilst promoting autonomy, collaboration, and acceptance. This is known as the '*spirit'* of the approach (Miller & Rollnick, 2013). Research evidence supports the use of MI within a range of health-related contexts such as harmful drug and alcohol use (Lundahl et al., 2010), smoking cessation (Heckman et al., 2010), and weight management behaviours (Armstrong et al., 2011; Moss et al., 2017). However, there are significant caveats to consider in terms of heterogeneity of research methods, the clarity of intervention content, and the risks of bias in study designs (DiClemente et al., 2017; Lundahl et al., 2013).

Whilst work has examined the content of interventions for behaviour change (Michie et al., 2013), and the outcomes of MI when the approach is used as an intervention (Rubak et al., 2005; Lundahl et al., 2013; VanBuskirk & Wetherell, 2014; Knight et al., 2006), it is also important to consider the interpersonal style and specific intervention components of this complex approach (Hagger & Hardcastle, 2014). MI emphasises the elicitation of the patient's reasons for the desired change, and plans are produced in partnership (Miller & Rollnick, 2013). Elements of MI have been clarified by Hardcastle and colleagues (Hardcastle et al., 2017) as including relational components such as *coming alongside* (acceptance and reflection of ambivalence towards change) and *affirmations* (highlights of the patient's efforts and strengths) in addition to other content-based

techniques such as prompting reflection on perceived confidence or importance in relation to the change goal, known as *confidence/importance rulers*.

Research has sought to identify which elements of MI account for effectiveness. Studies have focused on various theoretical mechanisms underpinning the approach such as the *relational* hypothesis and the *technical* hypothesis (Miller & Rose, 2009, Copeland et al., 2015, Apodaca & Longabaugh, 2009, Romano & Peters, 2016). The relational hypothesis points towards the importance of therapist-client factors (such as empathy, supportiveness, and the *spirit* of MI) in effectiveness. Conversely, the *technical* hypothesis suggests that the MI skills utilised by practitioners are related to a greater number of patient comments which are in favour of change ('change talk'). Change talk predicts treatment outcome and has been supported by meta-analysis of change talk studies (Magill et al., 2014, Magill et al., 2018), whilst evidence in support of the relational hypothesis is more limited (Copeland et al., 2015). Within the broader field of therapy- and counselling- based approaches, therapist effects account for some effectiveness (Johns et al., 2019; Crits-Christoph et al., 199, Del Re et al., 2012). This variable means that the relational factors of behaviour change support may be more appropriately studied in observational research settings as opposed to clinical trials (Magill et al., 2018) and warrants further study to elucidate the role played by empathy, supportiveness, and the *spirit* (Magill et al., 2019). MI may require a re-learning of communication skills (Keeley et al., 2018) necessitating mindful determination to avoid slipping back to use of non-MI consistent behaviours such as closed questions or attempts to 'fix' the issue without permission (Shannon et al., 2017; Miller & Rollnick, 2014). What is implemented in professional practice may differ from the skills and approach outlined in learning and training (Atkinson & Woods, 2017; Hall et al., 2016; Lim et al., 2019). Identification of which elements are transferred into practice is important for future research of effectiveness.

To develop the evidence base and identify implementation challenges which may occur with the application of the of MI, a richer understanding of how MI is perceived by professionals was required. A more thorough understanding of what is being implemented is important for future evaluation of complex interventions (Craig et al., 2008). By identifying what patient-facing health

professionals with knowledge of behaviour change approaches perceive MI to encompass, a clearer picture can be built of (*a*) its current practical application, and (*b*) the process by which professionals understand the approach to work in supporting patients with behaviour change. This study therefore aimed to answer two specific research questions:

- What did practicing health professionals who had received training in MI currently understand it to involve when utilised in their practice in terms of the skills, delivery, and underlying components?
- How was MI perceived by practicing health professionals to support health-related behaviour change in their patients?

2. Methods

A *Consolidated Criteria for Reporting Qualitative Research* (*COREQ*, (Tong et al., 2007)) checklist is included in the Appendix (Appendix g) which provides detail regarding aspects of the research team (myself and my supervisors) and reflexivity, study design, and analysis reporting.

2.1. Sampling and design

Purposive sampling was used to recruit participants working across different healthcare settings and with differing experiences of MI to take part in semi-structured interviews. Inclusion criteria were i) current employment within a healthcare setting (or no longer employed, but to have left the role within the previous 5 years) and ii) to have received some form of training in MI. Recruitment adverts were shared on social media sites (e.g., Twitter, Facebook; Appendix d) and clinical practice professional association websites with the researcher's email address. Contacts of the research supervisors working in clinical practice settings were also invited to share the study with others. Interested individuals were sent the information sheet (Appendix c), which provided detail about the study aims and study involvement. Following completion of interviews participants were invited to share researcher contact details with others as part of additional snowball sampling to maximise reach and were provided with a participant debrief form (Appendix f). All participants received a £10 electronic gift card as reimbursement for their time.

2.2. Data collection

Interviews were conducted via telephone, face-to-face on university campus, or Skype, between October 2018 and December 2019. They took place on a one-to-one basis with a PhD researcher (HM) with Motivational Interviewing training and experience in qualitative interviewing. The majority (92.8%) took part via distance methods. A semi-structured topic guide was piloted with researchers and individuals working in healthcare with prior training in MI. In brief, the topic guide was tailored to level of MI experience and covered three main areas: (1) experiences of training and learning about MI, (2) experiences of using MI in practice and (3) beliefs and understanding of MI. Individuals who reported that they did not utilise MI skills in their practice were interviewed using an adapted topic guide that prompted views and experiences of MI training and application of general communication approaches to behaviour change (Appendix e). This was intended to provide understanding of their communication style which may overlap with an MI-consistent approach. Both topic guides are provided in the supplementary materials. Recruitment and data collection ceased when researchers considered thematic saturation was reached by no new or contrasting responses being presented during interviews (Francis et al., 2010). Audio recordings were transcribed verbatim using NVivo 12 (QSR International Pty Ltd.) and transcripts checked against the audio for accuracy. Participants were invited to review transcripts before inclusion in the analysis. This is thought to support the trustworthiness of findings through providing opportunities for participants to share further insights or commentary on the transcription; however, can create an additional burden for participants, and may not result in changes or new information to the data (Motulsky, 2021). No participants requested to review their transcript.

2.3. Ethical considerations

Ethical approval was obtained from The University of Liverpool Research Ethics Committee (Reference 3479, Appendix a). All participants provided written informed consent prior to interviews. Any identifying information recorded in the interview was replaced with generic labels during

transcription, and participants were referred to with a unique non-identifying label in study analyses and reports.

2.4. Analysis

An inductive thematic analysis was conducted to explore participant responses (Clarke & Braun, 2013). NVivo 12 software, Microsoft Word, and handwritten annotations of transcripts were used in the analysis process. Initially, the researcher familiarised themselves with transcripts through repeated readings. Each transcript was reviewed and coded by labelling the essential meanings of responses with short summaries relevant to the research questions. Codes were collated together based on similarities or differences and further grouped according to concepts. Two transcripts were independently coded and discussed by multiple researchers (HM, AC, VF) to reduce researcher bias and define patterns in the data. Coding was grouping categories of similar concepts around a central concept to summarise the theme '*essence'* (Clarke & Braun, 2013). Relevant quotes and written summaries were pulled together to accurately represent the spread of each theme across the available data. Themes were further refined by examining transcripts in turn and via researcher discussion. Finally, themes were named according to the interpretation to provide a clear summary of the theme content and written definition created. Analysis was conducted primarily with one researcher (HM) and reviewed with the co-authors to ensure data adequately supported the identified themes.

3. Results

3.1. Participant characteristics

Fourteen individuals took part in semi-structured interviews, of whom two reported not utilising MI within their roles. Thirteen (92.8%) were based in the UK or Ireland and one participant was based outside of the EU. Three participants (21.4%) were male and 11 (78.6%) were female. Professional roles and utilisation of MI skills are reported in Table 7. Interview durations ranged from 22 to 60 minutes with a median duration of 38 minutes.

All practitioners identified similar conceptual understanding of the core skills of MI. Open-ended questions were used by practitioners to collect information from and engage with individuals and were deemed useful because they invited a broad range of responses. Affirmations were described as statements which recognised patient effort, skills, and resourcefulness. Reflections mirrored elements of the patient's conversation and were particularly important for demonstrating understanding and active listening. Summaries were used as a form of checking in with patients during the consultation and confirming understanding.

"I think as well that kind of rapport building is really key, and what I really like about MI is the focus on summaries as well. I think it can be quite easy to just ask question after question and not necessarily check in with the patient. And a way to show that you're understanding and help them feel that you understand, cos I think that's really important." (Participant 4, Health Psychologist).

Adoption of the MI *spirit* was an important amendment to established practitioner attitudes; it required making changes to existing approaches and allowed conversations to explore the rationale for in-depth change.

"The spirit is a bit like… you can do the skills independently, ask all the questions, reflects, but without the spirit, which is the belief in people…it's kind eyes to me, that's the spirit…. because everything else will work if you shut up believing that you can actually solve it for them." (Participant 8, Practice Nurse).

Table 7. Participant professional roles and information relating to frequency of MI use.

Participant ID Number	Professional Role	Is MI utilised in their role?	
01	Dietician in Weight Management Services	Yes	"In my professional role, everyday."
02	Dietician in Weight Management Services *	Yes	"Every single conversation that I have. Not even just with patients but with colleagues, with other health professionals that I work with, students when I'm giving feedback. It's just become ingrained in all of my approach. And outside of work as well."
03	Physiotherapist in Weight Management Services and Academic Researcher	Yes	"Every single consultation. All the time."
04	Health Psychologist and Academic Researcher	Yes	"I would say I use them in every clinic I have."
05	Endocrinologist	Yes	"I try! …I can't say I'm very much [applying] with my skills maybe…"
06	Professional Midwifery Advocate	Yes	"Every day."
07	Trainee Clinical Psychologist	Yes	"You can use it in little bits…having a knowledge of MI…is really helpful."
08	Practice Nurse *	Yes	"All the time."
09	Health Psychologist in Weight Management Services	Yes	"At least twice a week."
10	Counsellor *	Yes	"Every day."
11	Health Psychologist and Academic Researcher	Yes	"…I have clinics twice a week…so definitely use it twice a week.."
12	Dietitian in Weight Management Services	Yes	"Every day, whether it's in a group capacity or on one-to-one… every day, in all my consultations."
13	Health Trainer and Health Promotions Lead	No	"I've never sort of used MI when I was working in patient facing roles… a lot of people it just wouldn't work."
14	Foundation Year Doctor	No	"So I think mainly in [previous setting; General Practice] where the setting is more lifestyle."
* = Participant had been involved in delivery of MI training or offered MI training.			

3.2. Themes

Five themes were identified. These were; 1) Challenges in building competency, 2) Weaving MI skills into practice, 3) When to use MI and when not to, 4) Impact of the external environment, and these contributed towards the core theme of practitioner experiences with MI and 5) Enabling a deep understanding of the individual and their strengths. Theme 5 was the core theme which related to all other themes in the dataset and directly addressed the second research question regarding practitioner beliefs surrounding what makes MI effective in practice. This understanding was facilitated by having a solid base of understanding of the purpose of the core components of MI as empathic and collaborative, and through having opportunities to practice and improve their skills within their workplace setting (Themes 1 & 2). Practitioners discussed reasons for and against the use of MI skills within their professional role (Theme 3) which was affected by their responsibilities and environmental factors such as the length of contact available with patients (Theme 4). Each theme is presented below in detail with illustrative quotes and non-identifying participant numbers in parentheses. Additional quotes are provided in Appendix h.

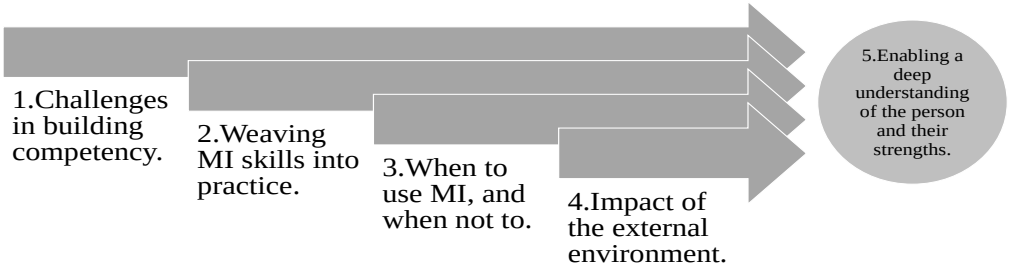


Figure 7. Thematic diagram demonstrating the identified themes describing practitioner perspectives of the underlying MI approach and its application to health-related behaviour changes .

3.2.1. Challenges in building competency

Participants discussed that there were challenges associated with using MI skills as it was a change in their approach. MI competence could only be built via an understanding of the key skills, with this being necessary to be able to practice and apply their knowledge correctly.

"…like, it wasn't really difficult, it's not astrophysics is it, but because I think it's just a new way of thinking." (Participant 3, Dietitian).

Practitioners firstly needed the opportunity to apply their knowledge in practice. However, practitioners highlighted it was often challenging to develop proficiency in MI due to conflicts from their existing approach (wanting to '*step in'*) with the underlying philosophy (needing to *'step back';* Participant 7, Trainee Clinical Psychologist).

"So yeah I find it really difficult, like MI it is challenging, and because it really takes a lot for me to take a step back and not step in to help people, in like a nice way, to really take a step back and let them do their thing. But in a way, it makes me wanna get better. Because when I see people do it really well, or when we've had training, I'm like oh that's amazing, how do you do that? So yeah. It's hard, but when it's done well it's really good and I hope one day to be able to do it that well." (Participant 7, Trainee Clinical Psychologist).

Whilst some participants considered MI to be more of an extension to their typical communication style, others considered it a modification to their usual approach that required more focus. In those who felt they had developed competence in MI, personal reflection, and even a change in one's identity were seen as necessary components in addition to experiential learning.

"I have to change, me as a person. To be able to practice in this way, it's not just the skill set. And the process of doing it - a lot of self-reflection." (Participant 2, Dietitian and MI Trainer).

Outside of individual growth, professional settings could also offer opportunities for developing competence via discussion with colleagues and clinical supervision, which contributed to building confidence and knowledge. They also reported various avenues for revision through

independent study and practice to develop their abilities. Given the broad range of topics that could be covered within training, courses that fully covered relevant theory and practical elements and wasn't too short in duration were also viewed as essential to be able to develop skills to a level that would benefit their patients.

"…A decent level of competence to actually see benefits…[training courses] would probably be at least two days or a week or something." (Participant 13, Health Trainer and Health Promotions Lead).

"So, it, and it will have been something that was integrated into the conversations when you had clinical supervision as well. So even though it was a while for the formal training to take place, it, it's kind of embedded into practice and embedded into conversations when you're in, in my experience in the clinical area where there's a lot of behaviour change." (Participant 03, Physiotherapist in Weight Management Services and Academic Researcher).

3.2.2. Weaving MI skills into professional practice

The second theme represented how practitioners applied their MI knowledge into professional roles. This required careful thought during patient interactions to avoid communicating in a non-MI way whilst guiding towards change. Concentrated effort was needed when implementing skills alongside other expertise. Whilst theoretically MI follows distinct processes, in practice it was interwoven alongside a combination of skills rather than in isolation. MI was *"not like a straitjacket, you put it on and you can't do anything else. It's a style."* (Participant 8, Nurse Practitioner).

This resulted in delivery of a tailored form of MI in routine practice amended to practitioners' own styles of working. MI could remain a central feature of all conversations about behaviour change, *"…Like a thread that runs through them all"* (Participant 7, Trainee Clinical Psychologist). Over time, knowledge application became easier, as skills became integrated into their practice and competency was attained, although it required a consistent, conscious awareness to ensure that they were applying MI skills;

"It's one of those things that you really need to be consciously in the present moment and know that you're using MI…it's not easy I don't think. I think the more you practice the more it becomes sort of embedded in what you're doing." (Participant 11, Health Psychologist).

"…I think it works quite well when there's a clear behaviour that needs to be changed… it works better with those things because there isn't any question about what the patient needs to be." (Participant 13, Health Trainer)

3.2.3. When MI is used, and when it is not

Practitioners described the decisions they made surrounding when to apply MI skills in practice. The situations where MI was considered appropriate included when practitioners wanted to offer support and demonstrate understanding. However, they also mentioned that an MI approach was not always relevant to the needs of the person.

Several practitioners referred to the role of MI in discussing individual reasons for and against changing behaviours. Understanding the individual reasons for change allowed formulation of bespoke plans which were tailored to the individual patient. It prompted the patient to share their perspective, and this made practitioners feel more at ease as there was reduced conflict within the consultation. MI consisted of technical elements but also a "*new way of thinking"* (Participant 3. Physiotherapist). This related to the spirit; compassion, promotion of autonomy, collaboration with the patient and evocation of their ideas surrounding the change and ambivalence. MI training developed communication skills that some participants mentioned applying to other situations outside of their professional role.

"I know it makes me feel better, and much less likely to put my foot in it… If you're empowering the other person in the conversation, you're not going to leave the conversation the wrong way." (Participant 6, Professional Midwifery Advocate).

However, MI was not relevant for all conversations, such as when treatment was actioned *to* or *on* the patient. Sometimes it was necessary to utilise non-MI skills to ensure the correct treatment was provided. Specifically, closed rather than open-ended questions were discussed as something

viewed as inconsistent but necessary. Patient preferences were an important factor in determining if the approach was suitable. Sometimes, patients preferred a practitioner-led plan, and in these circumstances the practitioner would use less MI techniques within the appointment.

When considering the perspectives of non-users, several key points were identified. Participants were aware that MI was appropriate as a tool in patient-centred care, and they were supportive of a patient-centred approach to behaviour change. However, they felt MI skills were inappropriate to use due to lack of engagement with patients, particularly in settings where they may not have repeated or continuous contact. Their reasons for non-use of MI in their role were related strongly to the concern over timing and ensuring patients left with the necessary information about their health;

"I think a big part of using [MI] is hoping that they'll come back. So you can build on their experience. But sometimes if you don't know if they will so you give them the information. Although it should be like them coming up with the ideas and all this, sometimes you just have to tell them you know what I mean." (Participant 14, Trainee Doctor).

However, it was felt that sometimes MI approaches simply didn't align with the needs of the patient. This would lead to frustration and resulted in defaulting back to a more prescriptive approach to ensure that patients who wanted to be given information and instruction received this.

"Not everybody responds well to it, I could think of some patients who really wanted to be given information... I'd start off questions about their motivations and they would literally ignore those questions, change the subject, start talking about something else. It definitely depends on the individual, some people like to talk about their thoughts and feelings and some people don't. You know, respond to a much more prescriptive approach." (Participant 13, Health Trainer and Health Promotions Leader).

3.2.4. Facilitators and barriers to MI implementation from the external environment

The fourth theme considered the impact of practitioner surroundings. In comparison to individual considerations discussed within themes 2 and 3, there were wider determinants which

contributed to implementation of MI. Having a culture at work that was supportive of open discussion about communication was valuable to practitioners. For many participants, their colleagues had also received training in MI and had physical prompts in the workplace to remind them of their skills or training knowledge. This was advantageous for drawing on support from peers.

"So if you're in an environment [workplace] *where* [other staff] *they're open to change, they're open to trying new things, don't have all the answers, I think then they're gonna be much more supportive of trying things like [MI]." (Participant 3, Physiotherapist).*

Their role responsibilities affected how MI fitted into professional practice. For participants with limited or brief contact with patients, they queried how effective it was for ensuring patient-led change.

"I think that a big part of MI is them coming to the conclusions themselves, isn't it. I think that depends on how long it takes, and the time it wouldn't be a problem if you know you have a regular appointment, they're going to come back, but people often don't." (Participant 14, Trainee Doctor).

"They [other practitioners] *have very few minutes to talk to their patients… to learn all of the things about their patients. So I have thirty to forty minutes, I can use MI. Especially when patients come to me [a] second or third time." (Participant 5, Endocrinologist).*

Both practitioners who had limited time and those who typically had longer consultations highlighted this. However, some practitioners had a different perspective, that the agenda setting element of MI was actually very valuable in shorter interactions with patients.

"…it actually saves time because you talk about the things that they need to talk about." (Participant 6, Professional Midwifery Advocate).

3.2.5. Enabling deep understanding of the person and their strengths

"…Even when they're describing, inverted commas, 'bad behaviours', I'm trying to view it from their perspective... what I'm trying to do is understand their motive… how can they achieve that desire but in a different way?" (Participant 10, Counsellor).

The final theme represents practitioners' views on why MI may be effective. Participants discussed the need for empathy and collaboration in behaviour change planning. MI was a practical way of ensuring they were able to take patient viewpoints into account to understand contributing factors. Integrating an MI approach into their practice enabled understanding of the individual's experience. This understanding supported a team effort to identify potential avenues of change. Practitioners commented on the differences of this approach to provision of instruction in steps they knew would be successful but may not be the personal preference of the patient.

"I feel like if you're adopting the spirit of MI it's that empowering of the person which feels much nicer. […] I've shadowed […] whoever and they just say 'oh you know, […] you shouldn't do this.' […] I can imagine it feels quite blaming and quite helpless and like you've done something really wrong rather than taking an MI approach. That's like, 'oh okay so you drink a lot of alcohol, like what are the pros and cons,' or you know offering information if they want to rather than forcing it on them. […] I feel like they'd know the difference and I feel like they'd feel a bit happier if they had an MI approach rather than if it wasn't. It's not nice..." (Participant 7, Trainee Clinical Psychologist).

This changed their previous practice by further focusing on patient values. An MI style of conversation was considered more effective at achieving behaviour change, as the behaviour was theirs to change and supported the autonomy of the individual in their choices.

"…ultimately I think it helps to empower the patient and to give them autonomy because you know, I don't like them to see me as the authority figure…it's more about them taking charge as well." (Participant 11, Health Psychologist).

4. Discussion

This interview-based study investigated (1) the experiences and knowledge of healthcare practitioners in utilising Motivational Interviewing (MI) skills in their practice, and (2) healthcare practitioners' understanding of how it may work to support change within health behaviour contexts. The identified themes were 1) *Challenges in building competency,* 2) *Integrating MI skills into practice,* 3) *When to use MI and when not to,* 4) *Impact of the external environment,* and 5) *Enabling a deep understanding of the individual and their strengths.* Understanding was framed as the skills learned and applied to their work, and the core spirit. This was the style of communication with another individual and central to their application of MI. It was their willingness to empathise and respect the decisions of the patient. For several participants, this change from their previous style and had benefits for the practitioners themselves. Some, including non-MI users, felt that an MI approach could make it more challenging to provide information and that it was necessary to adapt use of skills. In relation to the second research objective to understand perceptions of MI supporting behaviour change, it was viewed as more likely to see positive patient outcomes using MI. This was because reasons for and plans towards change were guided by the practitioner but determined by the patient themselves.

All participants discussed a similar understanding of skills despite differences in training experiences, professional setting, and application of knowledge. The key competencies reported were comparable to those identified in a qualitative study in sports contexts (Mack et al., 2020). The MI spirit was a key underlying factor. Participants expressed the value of relational factors within MI in building a supportive and collaborative base for discussion about change. This is similar to work examining patient experiences which features autonomy promotion and ongoing support as valued by patients (Brobeck et al., 2014; Hardcastle & Hagger, 2011).

Challenges in developing competency were linked to training experiences, but also to amendments to existing professional practice such as adding a collaborative style and empathic approach. Recent concept mapping research (Atkinson et al., 2020) reported that amongst attendees from multiple professions at an MI training, less than half identified empathy as a key concept. The

researchers suggested that this was representative of the knowledge of those with less prior understanding of MI. A systematic review within addictions settings (Hall et al., 2016) found that only 2 of 11 studies reached 75% of clinicians reaching beginning proficiency in the *spirit* of MI. It is possible that literature has not addressed these relational factors of interpersonal nature, particularly if the focus is on technical components ((Hagger & Hardcastle, 2014; Hardcastle et al., 2017) in assessments of intervention fidelity. Relational styles have not consistently been related to change talk within reviews of hypothesised l MI processes (Romano & Peters, 2016), but methodological quality may impact on research investigating MI spirit as a mechanism of action (Copeland et al., 2015).

Practitioners also discussed changes to their intrinsic way of working. A person-centred approach involves a productive and supportive partnership which empowers the patient to be an active party within their healthcare treatment (Eklund et al., 2019; Resnicow & McMaster, 2012; Sharma et al., 2015). Adopting a person-centred approach to their role went further than utilising core skills. Several referred to the difference between *understanding* of MI skills and *mastery* of them. MI facilitated understanding by emphasising the importance of empathy and autonomy. Other studies have also reported that a commitment to MI was needed for its effects, and that MI also had benefits for practitioner feelings of autonomy and control in their workload (Lindhardt et al., 2015). However, professionals have previously reported that MI also creates new demands on their ability to maintain a consistent approach to their skill use (Brobeck et al., 2011; Shannon et al., 2017).

Previous work has focused on participants who actively implemented their skills. The current study expands this by attempting to elicit views of non-users; in this case, they reported appreciation of the person-centredness of MI, although separate pragmatic issues (discussed in theme 4, *when MI is used and when it is not*) meant they did not consider themselves as routinely integrating it into their role. They made decisions about when to use MI skills. This included using MI to support their own enjoyment of the role. Qualitative research with nurses has reported similar findings about motivations for use of MI, described by Ostlund and colleagues (Östlund et al., 2015) as overcoming internal resistance towards the change in practice, an encouraging workplace, and MI offering mutual benefit for practitioners and patients.

Some participants had concerns about the utility of MI in certain settings. In the current study, a non-user felt that there were situations when patient-led plans were unlikely to work. Other research with dental staff reported that practitioners made decisions about the applicability of skills to their setting, for example, issues with implementation of skills when it was not patient preference (Curry-Chiu et al., 2015). Similarly, nurses working with children and young people described that in some cases, it was necessary to take a non-MI approach and make a recommendation or instruction (Bonde et al., 2014). Alongside other studies (Lindhardt et al., 2015) participants discussed feelings of a lack of time affecting their confidence in applying MI skills. However, others felt timing was not a concern as the MI ethos could be applied regardless of the duration available.

Extrinsic factors contributed towards being able to put a person-centred approach in place, such as a workplace culture open to change and development. A mixed-methods investigation (Lim et al., 2019) into the implementation and maintenance of MI found that focus on the patient-centred manner, professional development, and process improvement were key elements necessary for the sustainability of MI. At an organisational level, developing a shared vision and culture supportive of professional development were important. Previous research has often focused on practitioners from the same team or setting (such as (Curry-Chiu et al., 2015; Lindhardt et al., 2015; Östlund et al., 2015). The current findings agree with this. Participants were from a range of settings and discussed the need for an encouraging atmosphere open to trying MI as an important support. They wished to have opportunities for practice and supervision, and some had procedures in place for reaffirming the culture of MI.

A central concept was how MI enhanced understanding of the individual, offering a personalised pathway and form of support. In clinical populations, this counselling approach may encourage feelings of autonomy and engagement in participants (Kertes et al., 2011). However, where conversation is utilised as the intervention, it is difficult to separate the practitioner from its effects (Miller & Moyers, 2017) and relational components potentially account for mechanisms of action sometimes referred to within counselling literature as nonspecific or general effects (Miller & Rollnick, 2014). Examination of interpersonal features is important for understanding how it may

support behaviour change (Hilton et al., 2016) and shed light on the causal pathway. Research involving coding of MI sessions has identified that the combination of technical and relational factors such as reflection, expressions of empathy, affirmations, and individualisation of problem solving are related to improved patient self-care (Riegel et al., 2016) and may account for effectiveness. Some research (Copeland et al., 2015) of health behaviours has identified that the core spirit may influence change. In the area of addiction, meta-analysis has not supported that the core spirit impacts behaviour outcomes (Magill et al., 2019).

However, other research has noted that structural and social determinants of health can create barriers to change beyond individual management ((Braveman & Gottlieb, 2014; Chow et al., 2009; Marmot et al., 2012). For example, several participants within the current study worked within weight-management. Factors such as food insecurity, marketing of and access to high-fat and high-sugar food and drinks, and built environments unsupportive of physical activity are common (Bryant et al., 2015; Lakerveld & Mackenbach, 2017). Further, physiological and metabolic research in obesity have identified successful pharmaceutical and surgical interventions that may be more effective in supporting long-term bodyweight reduction than solely behavioural interventions (Dombrowski et al., 2014; Gloy et al., 2013), although there are issues with clinical trial attrition and continuation of use due to side effects of medication used (Hollywood & Ogden, 2016).

4.1. Strengths and limitations

Only two participants responded to screening questions indicating they did not use MI skills. This was due to changes in their professional role and activities. Recruitment advertisements inviting those who had received training in MI likely indicated a self-selecting sample of those with a pre-existing interest in the approach and willingness to discuss. Future work would benefit from alternative recruitment methods to ensure a diverse range of responses, and more targeted recruitment methods. However, the sample size was adequate for providing a richer understanding and identifying similarities across the data involving participants who worked within different behaviour change contexts. Although participants were invited to review transcripts, no participants opted to. Checking

transcripts with participants is a commonly used approach to check the accuracy and clarity of transcripts (Hagens et al., 2009).

As participants commented on the development of skills and understanding over time, work could also investigate experiences during and following training courses and implementation of MI skills to their practice. Specific training in person-centred approaches significantly increased use of these skills in comparison to untrained staff (Lawrence et al., 2016). Considering the importance of clinical communication skills for practitioner and patient benefit (Boissy et al., 2016), longitudinal work could assess practitioners over time.

This study has examined the practitioner-perspective of processes as recommended (Hilton et al., 2016). Future research could consider the relationship between patient and practitioner together which may present new knowledge about the content of collaborative efforts, and effects of this on outcome assessments. Additionally, clarification of the behaviour change components which support change in practice could be examined through coding-based approaches that use a standardised list of behaviour change techniques. This would provide an evidence base of what works in health behaviour interventions and within specific populations or health behaviour contexts.

4.2. Conclusions

This qualitative research study identified what informed practitioner understanding and application of MI knowledge, namely the impact of learning experiences on their confidence, the role of the wider extrinsic setting-related factors on the implementation of their knowledge, and how this supported behaviour change. Ultimately, understanding of MI frequently related to the underlying core spirit of MI principles despite differences in learning and training experiences and supported that a key aspect of any behaviour change conversation is the interpersonal delivery method utilised. Practitioners were experienced, but welcomed opportunities for further training and supervision experiences to build confidence in MI.

4.3. Practice implications

Use of MI within healthcare was considered an effective relationship-building approach to change discussions by practitioners from varied settings. MI allowed plans to be developed according to the patient's own goals and ideas, although practitioners noted importance for guiding this to shape appropriate and feasible actions. However, opportunities for further training and supervision were desired alongside a working environment that supported changes to practice.

Chapter 5. Identifying the active components of Motivational Interviewing applied to physical activity behaviour change conversations.

Foreword

After conducting two studies that identified potential mechanisms for the effectiveness of Motivational Interviewing (MI) within health behaviour change, inconsistent information regarding the methods used within MI research studies was identified. This suggested that that further research was required in order to clarify the components of the approach that could be identified within conversations working towards a specific behaviour change goal. This would support research efforts by using a design that clearly reported the intervention components and permitted replication of interventions. Therefore, the current chapter reports the findings of a single-group intervention study that investigated the behaviour change techniques present within MI conversations focused on physical activity behaviour change.

1. Introduction

Physical activity (PA) is an important component of healthy living (Warburton et al., 2006; Warburton & Bredin, 2017) both as a method of reducing the risk of poorer health outcomes and improving wellbeing (Penedo & Dahn, 2005). This can take the form of formal activities such as team sports, gym attendance or unstructured activity such as walking or gardening. Currently, 1 in 4 adults are not considered to meet target levels for PA (World Health Organisation, 2022), with possible explanations including proximity of access to environments such as sports or community centres, and opportunity to participate, such as having financial resources to attend fitness centres (Estabrooks et al., 2003). Participation rates for PA indicate that many people do not meet guidelines of 150 minutes per week (Department for Digital, Culture, Media and Sport, 2022). It is important to promote engagement and offer support to individuals to increase activity levels (Reichert et al., 2007). More tailored support for individuals appears to be more effective than "one-size fits all" interventions, and government bodies have called for interventions that can address multiple determinants of behaviour (e.g., environmental, social, and contextual contributors to health and wellbeing) (Murray et al., 2017; Public Health England (PHE), 2010).

One such approach to increasing activity is Motivational Interviewing (Miller & Rollnick, 2013). MI is a directive, person-centred approach to communicating about change. A four-stage process approach including *engagement* with the individual, *focus* on a specific concern, *evocation* of their personal reasons for change and *planning* for the behaviours they would like to amend is commonly used (Miller & Rollnick, 2013). Of particular importance is the *spirit* of MI (Moyers, 2014); the relational element whereby the practitioner adopts an empathic, non-judgemental, understanding approach. Research has investigated the effectiveness of MI for a wide range of outcomes including health behaviours such as weight management (Armstrong et al., 2011), smoking (Lai et al., 2010), and substance use (Smedslund et al., 2011, Barnett et al., 2012). *Capability*, *Opportunity* and *Motivation* to engage in the activity are important determinants of behaviour change (COM-B Model; (Michie et al., 2011)). Within the specific behavioural domain of PA, *Motivation* and levels of moderate intensity and higher activity were predicted by scores on *Capability* and

Motivation (Howlett et al., 2019). MI may be effective in increasing these behavioural determinants and promoting the development of an individual's sense of autonomy and competency (Deci & Ryan, 2012). Meta-analysis of studies implementing MI for PA increases within populations with chronic illness identified that it had a small but significant effect compared to non-MI groups (O'Halloran et al., 2014), with improvements in studies that utilised treatment fidelity tools which confirmed the approach was being delivered as intended. A study with follow-up durations of 15 months reported significant improvements in leisure PA durations and improvements to physiological measures of blood pressure, heart rate, waist circumference and VO2 max scores (Sjöling et al., 2011) suggesting it may be an appropriate method of supporting the long-term maintenance of activity levels. However, MI is a complex approach that can be tailored for individual benefit. It is not yet clear what the mechanisms of action and components of MI delivered for behaviour change are, which is necessary for understanding what could be replicated for future success.

Therefore, questions remain regarding the active mechanisms of MI interventions, and which components of behaviour change models are directly impacted by the intervention. This has been repeatedly discussed within reviews of MI-specific research (Armstrong et al., 2011; Makin et al., 2021). The intervention may be appropriate for a range of behaviour change domains, but identification of mechanisms from published reports is challenging (Soderlund, 2018) due to limited reporting of intervention content. A systematic review of the literature investigating healthcare professionals' perspectives found that behaviour change counselling for PA was an important factor of their practice, however there were uncertainties about the effectiveness and training within counselling approaches (Hébert et al., 2012). Clarification of the underlying techniques utilised within MI and testing the effect of MI on behavioural determinants of change would address these concerns as it would be clearer what constituted effective delivery.

Researchers have utilised taxonomies such as the Behaviour Change Techniques (BCTTv1; (Michie et al., 2013)) and an MI-specific taxonomy of content-based and relational techniques (Hardcastle et al., 2017) to investigate the application of MI within PA counselling (Gagnon et al., 2018). It has been suggested that alongside clearer description of intervention components to support

development of effective implementation (Michie et al., 2013) that MI studies should report information regarding the duration, quantity and focus of sessions (Soderlund, 2018). further investigation of the effectiveness of MI in supporting PA behaviour change in this context is warranted.

There are mixed research findings regarding the most beneficial BCTs for physical activity behaviour change, although this may also result from the design of reviews not appropriately linking outcomes to meta-analysis outcomes (Spring et al., 2021). Research from Michie and colleagues (Michie et al., 2009) assessed techniques which were effective at supporting eating- and PA behaviour change. Self-monitoring explained the greatest proportion of variance in study outcomes, and it was more effective when combined with at least one other technique. Therefore, future research to clarify which techniques are effective, and for which outcomes, will aid understanding of what techniques are relevant for specific behaviour outcomes. To resolve this, research needs to examine the effect testing of individual techniques intended to produce behaviour change, consideration of study quality and clearer reporting of the theory base used in intervention development (Hagger et al., 2020).

The association between number of BCTs implemented and effectiveness is unclear (Dombrowski et al., 2012); the format of delivery, including empathy and relational components should also be examined to help explain effectiveness. A granular approach, using raw data from interventions to clearly elucidate what is occurring is of benefit to understanding of effective intervention techniques. One method of establishing the effectiveness is to compute ratios of the presence of BCTs within interventions that produce the desired change in behaviour (Martin et al., 2013). However, some elements of behaviour change intervention, such as the interpersonal style of delivery, may be omitted from BCT taxonomies. One important consideration is the relational approach used in intervention delivery, which researchers have recommended should be encompassed within content reporting (Samdal et al., 2017). An MI-specific list of techniques has been developed to address these concerns (Hardcastle et al., 2017). Within MI, content coding studies have reported the use of BCTs primarily from the *Goals and Planning* and *Feedback and Monitoring* groups such as

behavioural goal setting and self-monitoring and that most MI techniques fall into the *engaging* and *evoking* processes (MacPherson et al., 2020).

The current study intended to improve our understanding of effective components by allowing specification of the effective components of this complex intervention. Furthermore, it also intended to test the effectiveness of an MI intervention in supporting PA change. It was hypothesised that this would be an effective method of supporting increases in PA behaviour, and also that self-reported behavioural determinants would significantly improve from baseline to the end of the final session. The specific research aims were as follows;

- To investigate if MI was effective in improving participants' behavioural determinants (capabilities, opportunity, and motivation) of engaging in physical activity.
- To identify which specific techniques from the BCTTv1 taxonomy and the MI-specific content-based and relational techniques as defined by were present in effective MI interventions where participants increased their physical activity levels.

2. Methods

2.1. Participants

Participants were recruited through opportunity sampling from the University network through posters, online advertisements and mailing lists (Appendix l). Psychology students received course credit for participation. Eligibility criteria required that participants were 18 years or older, had a current interest in increasing their levels of PA and did not have any current health conditions that would permit changes to their activity levels, for example injury. No eligibility criteria for existing levels of physical activity were used; participants could be currently engaged in any amount of activity.

2.2. Design

The experimental study used a single-group, pre-post-test repeated measures design to evaluate the MI intervention. Measurements were taken at four time points (baseline; after the first session, after the second session and after the third session). To assess the application of techniques a content analysis of all recorded sessions was completed.

2.3. Materials

In the first meeting, participants completed a baseline questionnaire reporting their age, sex, height, weight, any pre-existing health conditions, and change domain of interest (a sport, structured activity, or unstructured activity). The primary outcome of interest was changes to participants behavioural determinants, discussed below. Participants completed the International Physical Activity Questionnaire (IPAQ-SF; Craig et al., 2003) at three timepoints (pre-session 1, post-session 2, and post-session 3). The IPAQ involves seven questions about participant's vigorous, moderate, walking, and sedentary behaviours and the amount of time spent on each activity. The IPAQ-SF was completed at the start of each session and provided a categorical score of low, moderate or high activity levels and a continuous score of metabolic equivalent minutes (MET minutes).

Participants also completed an unvalidated, 6-item measure assessing their levels of capability, opportunity and motivation using a 7-item Likert scale with answers ranging from, *"not at all*" to "*totally agree*". An example item is *"I am capable of doing physical activity in my life."* Higher scores indicated higher perceptions of capability, opportunity and motivation. The measure was completed on 4 occasions (the start of the first session and immediately following the first, second and third sessions). Test-retest reliability and internal consistency were assessed. Surveys were completed on paper forms and sessions were audio recorded on a Dictaphone (Appendix n).

2.4. Procedure

Participants attended the University campus to take part in a private behaviour change conversation with a member of the study team who had received training in Motivational Interviewing

(AC or HM). Upon attending, the researchers confirmed that participants provided consent to take part and for audio recordings (Appendix k). A member of the study team (HM, AC, or an undergraduate student who was supporting the study for course credit as a component of their small group project in collaboration with AC) completed the written measures with participants after gaining informed consent (Appendix m). The initial conversations elicited the participants interests about behaviour change, for example the topic of conversation that they wanted to discuss. This was a form of agenda setting that ensured their interests were covered and provided an opportunity for elaboration about what topics were discussed by others with an interest in behaviour change. This involved information gathering to determine current levels of activity and the intended goal. Towards the end of each session, when participants had determined what their change of interest involved, they were asked to identify specific timings, measurements, actions, and goals they would like to work towards and if there was anything they would like to discuss in subsequent sessions. Participants were provided with a debrief form (Appendix o).

Sessions were arranged to take place over a 4-to-6-week period (approximately one session every 2 weeks, allowing for deviations due to participant availability). Where possible, they took place in a private room in the Department of Psychology. Later sessions were also completed by telephone when the University campus closed due to the first national lockdown during the COVID-19 pandemic in 2020. Skype was also offered although no participants opted to utilise video calling. Sessions lasted up to 60 minutes with the average duration being 40 minutes. See Table 9 for summary information on the dose and duration of sessions across each timepoint. Ethical approval was granted by the University of Liverpool Research Ethics Committee (reference 5724), and all participants provided written informed consent to participate in sessions and for audio recording to take place.

2.5. Method of analysis

Due to the small sample size, analyses were limited to descriptive statistics of each timepoint. These are presented along with pre-post scores, mean difference, and related effect sizes (Cohen's d) from baseline to the final timepoint. A paired-samples t-test was run to identify effects on physical

activity metabolic equivalent (MET) minutes, a measure of energy expenditure. The frequency counts of BCTs coded as present within interventions are reported. Success was categorised as a score change of 0.5 or greater on combined COM-B determinants scores, between baseline and latest reported data. This was used as it represented a half standard deviation of change in scores from baseline to last observed datapoint. Whilst there was no uniform recommendation (Copay et al., 2007) for definition of clinically meaningful difference the standard deviation has been used within other research as an assessment of changes in patient reported outcomes (Norman et al., 2003; Rai et al., 2015). The identification of 'effective' interventions was used to create ratios which represent the effectiveness of specific techniques (Martin et al., 2013).

2.5.1. Coding analysis

Audio from the MI sessions was coded using the BCTTv1 (Michie et al., 2013) and an MI-specific list of relational and content-based techniques (Hardcastle et al., 2017). Coders completed the BCTTv1 online training module and calibrated their coding on a range of practice audio and MI session transcripts using both taxonomies. Discrepancies in coding were discussed and a rulebook developed. One researcher (HM) coded all sessions and 15% of all audio was second-coded (GH) to confirm accuracy. Percentage agreement and prevalence-adjusted bias-adjusted kappa scores (Byrt et al., 1993) were calculated.

2.5.2. Intervention fidelity

4 segments of 20 minutes from a random selection of audio recordings were assessed for fidelity to Motivational Interviewing approach using the MITI 4.0 tool (Moyers et al., 2016) by one author (HM) who had received MI training and supervision and completed practice fidelity assessment tasks previously. The MITI assesses relational (interpersonal) and technical MI skill use, with descriptive thresholds of 'fair' and 'good'.

3. Results

20 participants were included in the final sample, with a combined number of 43 sessions in total (see Figure 8 for participant flow diagram). All participants provided data related to behavioural determinants before and after the first session. 16 participants completed the second session data collection, and 15 participants completed the final session data collection. Participant characteristics are reported in Table 8.

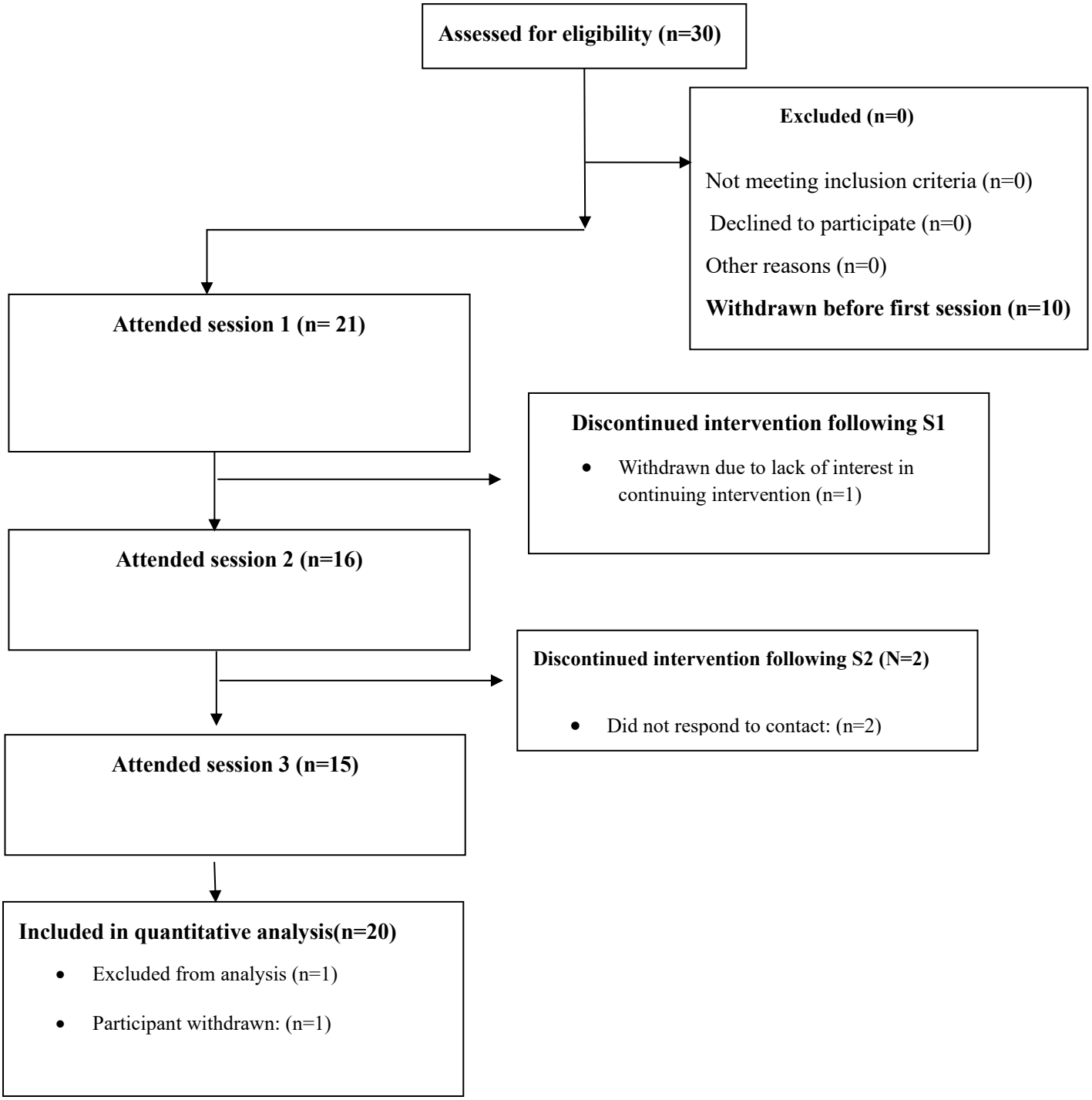
Table 8. Participant characteristics (statistics are median and range or frequency count)

Characteristic	
Age	19.50 (range 18 – 49) years.
% Female	90% female (10% male)
BMI[a]	22.86 (19.57 to 30.96)
Areas of physical activity interest:	
A sport	N= 1
A structured exercise	N= 14
Unstructured activity	N= 0
Not specified and/or a combination of the above	N= 5
[a]One participant did not provide bodyweight data.	

3.1. Intervention fidelity

4 audio recordings were assessed using the Motivational Interviewing Treatment Integrity tool (MITI;(Moyers et al., 2016)). Across the recordings, global relational skills (M=4.25, SD=0.65) and global technical skills (M=4, SD=0.41) were within the 'good' proficiency range and the percentage of complex to simple reflections was fair (40%). However, the reflection to question ratio was skewed in favour of questions (0.9:1).

Figure 8. Participant flow diagram



3.2. Behavioural determinants and activity

Cronbach's alpha was used to assess the internal consistency of the brief measure of behavioural determinants. α=70 has been suggested (Nunnally & Bernstein, 1994) as a lower acceptable bound for alpha. Descriptive statistics for each item and overall scores are reported in Table 9. Cronbach's α indicated there was acceptable internal consistency (α=.74). Correlations between baseline and post-session 1 data indicated a significant correlation for the items assessing capability (r (18) = .932, p<.001), confidence (r(18) = .630, p=.003), social support (r(18) = .894, p<.001), opportunity (r(18) = .796, p<.001), motivation (r(18) = .697, p<.001), and automatic motivation (r(18) = .751, p<.001). Correlation between the overall combined items at baseline and post-session 1 was also significant (r(18) = .845, p<.001) indicating generally acceptable test-retest reliability for the items and total score.

Table 9. Descriptive statistics (mean+SD) of behavioural determinant scores and MET minutes over time.

	Baseline (N=20)	**Post-session 1 (N=20)**	**Post-session 2 (N=16)**	**Post-session 3 (N=15)**	**T-test results**	**Effect size[a] of difference between mean scores from baseline to post-session 3**
Average session duration		48 minutes (31 minutes to 52 minutes)	38 minutes (15 minutes to 50 minutes)	39 minutes (20 minutes to 54 minutes)		
MET Minutes	2610.35 (1913.17)		2774 (2060.58)	3553.33 (2127.84)	t (14) = -1.60, p=.133	Cohen's *d* =0.41
Category of activity	5% low 50% moderate 45% high		12.5% low 31.3% moderate 56.3% high	6.7% low 20% moderate 73.3% high		
Capability	6.35 (0.98)	6.50 (1.00)	6.63 (0.50)	6.67 (0.49)	t (14) = -1.47, p=.164	Cohen's *d* =0.38

	Baseline (N=20)	**Post-session 1 (N=20)**	**Post-session 2 (N=16)**	**Post-session 3 (N=15)**	**T-test results**	**Effect size[a] of difference between mean scores from baseline to post-session 3**
Confidence	5.75 (1.21)	6.10 (1.07)	6.19 (0.75)	6.33 (0.82)	t (14) = -2.26, p=.041	Cohen's *d* =0.58
Social support	6.50 (0.83)	6.55 (0.60)	6.50 (0.73)	6.53 (0.74)	t (14) = .0, p=1.00	Cohen's *d* =0.00
Opportunity	6.40 (0.82)	6.25 (0.97)	6.19 (0.66)	6.40 (0.63)	t (14) = .0, p=1.00	Cohen's *d* =0.00
Motivation	5.05 (1.28)	5.90 (1.07)	5.88 (1.09)	6.20 (0.77)	t (14) = -3.02, p=.009	Cohen's *d* =0.78
Automatic Motivation	4.35 (1.42)	4.95 (1.05)	5.06 (1.24)	5.93 (1.10)	t (14) = -2.96, p=.010	Cohen's *d* =0.76
Combined scores	5.73 (0.74)	6.04 (0.66)	6.07 (0.58)	6.34 (0.65)	t (14) = -2.53, p=.024	Cohen's *d* =0.65

[a] Statistics are Cohen's d, calculated by dividing the mean difference between the baseline and post-session 3 scores by the pooled standard deviation. Data reported are mean and standard deviation unless otherwise stated. Due to non-parametric distribution of data, some variables utilise median and range.

9

A paired samples t-test of MET minutes from baseline to the final measurement (post-session 3) identified no significant differences, (t (14) = -1.597, p=.133, d=-.41). However, there was a significant difference in combined behavioural determinant item scores from baseline (M=5.69, SD = 0.74) to post-session 3 (M=6.34, SD=0.65), (t (14) = -2.53, p =0.24, d=-.65). See Table 9 for descriptive statistics and paired samples t-tests.

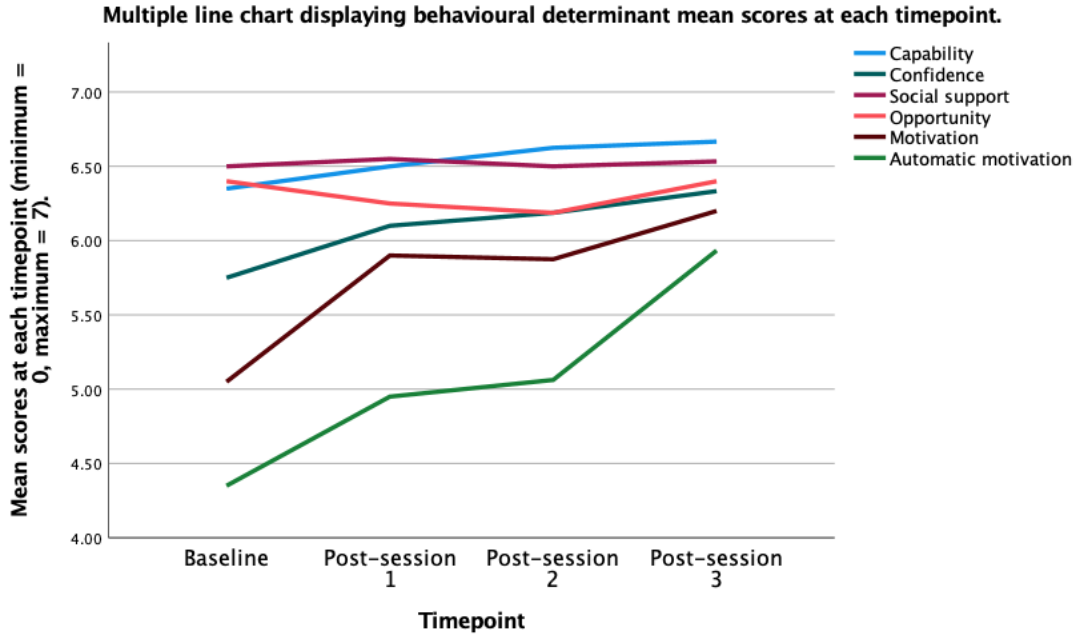


Figure 9: Line chart showing mean scores over sessions for each determinant category.

Figure 9 displays changes in mean scores for each behavioural determinant over the course of the sessions.

3.3. Content analysis

Content analysis of session audio was completed by one author primarily with 15% second-coded to permit for calculation of reliability assessments. Between coders, a good level of reliability was reached. Agreement ranged from 83% to 86% and the mean prevalence- and bias-adjusted kappa statistics (Byrt et al., 1993) was 0.69, indicating substantial agreement between raters.

21 of a possible 93 BCTs, and 37 of a possible 38 MI techniques were coded as present across 43 audio recordings. Overall, the most frequently coded BCTs were *action planning* (1.4), *behaviour*

goal setting (1.1) and *review behavioural goals* (1.5). The number of BCTs coded remained similar cross the progressing sessions. A mean of 6.1 (SD = 3.07) BCTs were coded in session 1, 5.85 (SD=5.85) in session 2, and 6.25 (SD = 1.48) in session 3. In session 1 the most coded BCTs were *action planning, monitoring of emotional consequences, comparative imagining of future outcomes,* and *behaviour goal setting.* In session 2, they were *review of behaviour goals, action planning, behaviour goal setting,* and *pros and cons.* In session 3, the most frequently coded techniques were *review of behavioural goals, action planning, behaviour goal setting,* and *framing/reframing.*

The only MI technique not coded was *Elicit-Provide-Elicit* (8), which is a content-based focusing technique. On average (see Table 10), there was 8 relational and 9.5 content-based techniques coded as present in session 1, and 7.2 relational and 9.3 content-based in session 2. There was an average of 7.1 relational and 8.4 content-based techniques in session 3. The most frequently coded techniques in session 1 were *open-ended questions* (relational), *reflective statements* (relational), *coming alongside* (relational), *summary statements* (relational), and *troubleshooting* (content-based). In session 2, they were *open-ended questions, reflective statements, summary statements, coming alongside and DARN (Desire, Action, Reason and Need) questions* (content-based). In session 3 the most frequently coded techniques were *open-ended questions, reflective statements, summary statements, agenda mapping* (relational) and *DARN questions.* Techniques from all four processes of engaging, focusing, evoking and planning were present. 52% of all techniques across all sessions were evoking, 22.21% were engaging, 17.76% were planning, and 8.02% were focusing. As recommended by previous work (MacPherson, Dineen, Cranston, & Jung, 2020) see supplementary materials for a summary of coding and change scores reported on a per-participant basis. Effectiveness ratios (Martin, 2013) were produced which represent the number of times a technique was present in interventions deemed successful divided by the total number of times it was coded as present across all participants (see Figure 10 and Figure 11). The techniques of *social comparison, commitment,* and *self-monitoring of outcomes of behaviour* had effectiveness ratios >70%. However, self-monitoring of behaviour was only coded in 3 sessions.

Within the MI-specific list of techniques, *undershooting, permission to provide information and advice, overshooting,* and *shifting focus* had effectiveness ratios of 100%. These techniques were each coded in between 4 and 5 audio sessions. This may inflate the effectiveness ratio estimates due to low frequency of use. *Goal Attainment Scaling, Normalising, reframing,* and *Agreement with a twist* were also present in sessions and had effectiveness ratios >70%, and were more frequently coded in audio (between 6 and 16 sessions).

Table 10. Proportion of content-based and relational techniques present in sessions (data are frequency count and percentage).

	S1	**%**	**S2**	**%**	**S3**	**%**
Relational	136	45.8%	94	43.7%	85	45.7%
Content-based	161	54.2%	121	56.3%	101	54.3%
Total	297	100%	215	100%	186	100%

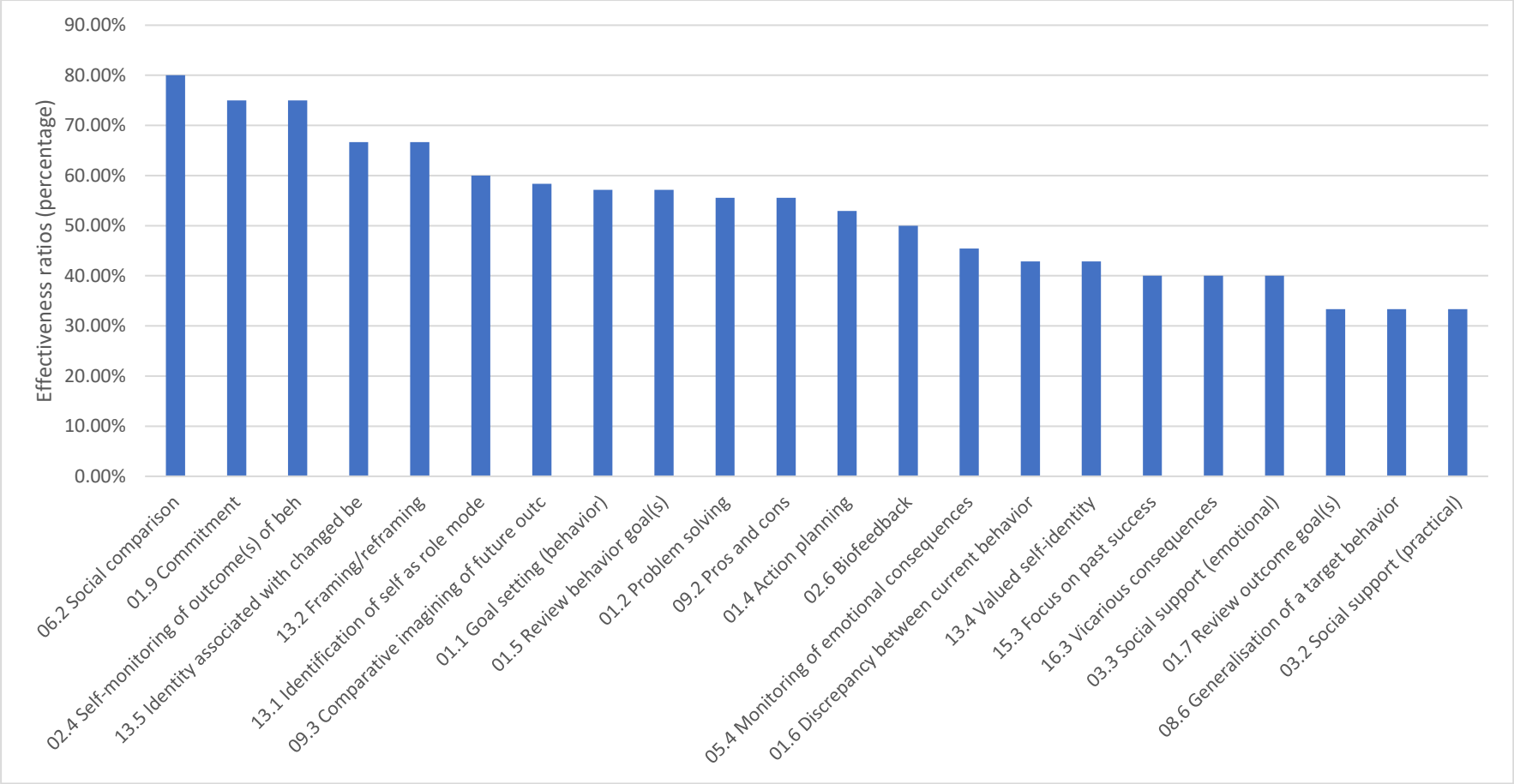


Figure 10. Effectiveness ratios for behaviour change techniques. Note: MI was not coded under 3.3 social support (unspecified).

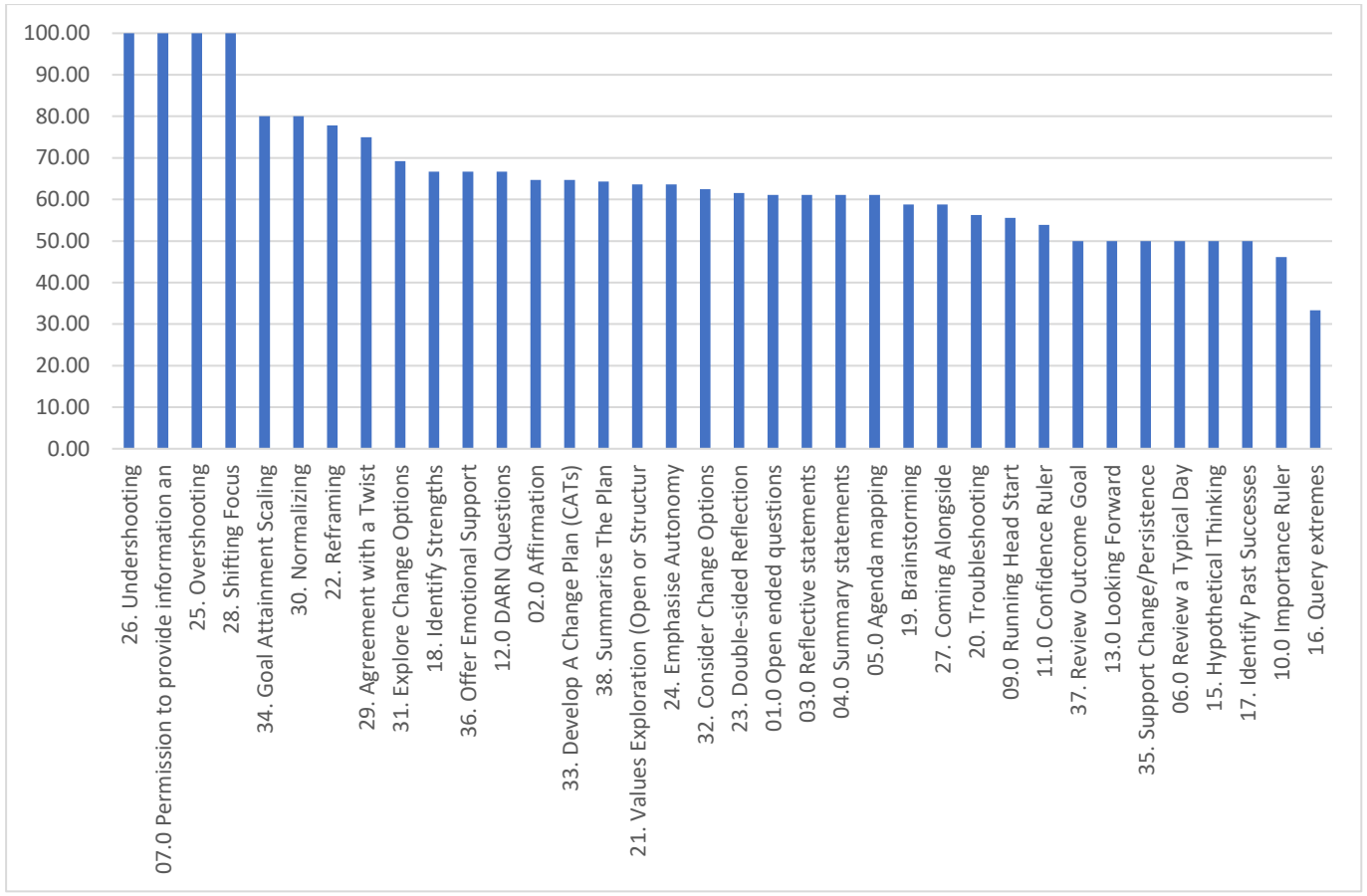


Figure 11. Effectiveness ratios of MI-specific techniques

4. Discussion

The current study investigated the effect of Motivational Interviewing (MI) on physical activity (PA) behaviours and the determinants of that behaviour. It also investigated the specific techniques present in this intervention using published taxonomies which can be applied to behavioural interventions and specifically MI approaches (Hardcastle et al., 2017; Michie et al., 2013). It was expected that PA quantity would increase, and that self-reported behavioural determinants would also increase between the study timepoints. Comparison of the pre- and post-test physical activity behaviours indicated no significant differences to PA levels between baseline and the start of the third session. However, there was a significant increase to a combined measure of behavioural determinants between baseline and the end of the third session. The most frequently coded behaviour change techniques (BCTs) from the Michie taxonomy (BCTTv1; (Michie et al., 2013)) were *action planning, behaviour goal setting* and *review of behavioural goals.* The most frequently coded techniques specific to MI (Hardcastle et al., 2017) were *open-ended questions, reflective statements, summary statements, agenda mapping* and *affirmations.* To summarise, the exploratory investigation of the intervention's impact on the behavioural determinants identified an improvement to scores. However, this increase was not complemented by increases in actual PA behaviour within the current sample, although this may be partly explained by the small sample and wider background of national lockdowns in which the study took place. National lockdown pointed towards the need for social distancing and the closure of leisure and sports facilities, as well as limits on outdoor activity time within the UK (Institute for Government, 2022). The deterioration in physical opportunity scores between sessions 2 and 3 may reflect the need for consideration of intended behaviour changes due to the wider contextual factors.

There are similarities to previous literature examining the content of MI sessions for PA. A study by Gagnon and colleagues (Gagnon et al., 2018) completed technique coding of PA counselling sessions to investigate the feasibility of MI-specific techniques (Hardcastle et al., 2017) and found it to be a reliable method of providing additional information about intervention components. Techniques were primarily from the *Goals and Planning* and *Social Support* categories

of the BCT taxonomy (Michie et al., 2013) and the *Engaging* and *Evoking* processes of the MI technique list (Hardcastle et al., 2017). This is comparable to the present study, which found most techniques coded were from the *Goals and Planning* group and the *Engaging* and *Evoking* processes.

MacPherson and colleagues (MacPherson et al., 2020) coded a community-based PA intervention for MI techniques and BCTs. Most techniques were within the categories of *Goals and Planning, Feedback and Monitoring,* or *Repetition and Substitution.* Of MI techniques, the majority (75%) of those coded fell into the *engaging* and *evoking* categories, although techniques from all four processes were identified. In the current study, techniques from all four stages were present in each session (*engaging, focusing, evoking,* and *planning*). 52% of all techniques across all sessions were evoking, 22.21% were engaging, 17.76% were planning, and 8.02% were focusing. The lower percentage of focusing techniques could be as participant inclusion criteria included a current interest in changing PA behaviour. Participants joined the study with an interest in engaging with behaviour change and agreement with motivation items at baseline was relatively high (averaging 5.05 of a possible 7 for motivation, although lower for automatic motivation at 4.35). Therefore, with the current sample, the breakdown of techniques may represent the need for tailoring sessions to concentrate on *evoking* individual reasons for change to build motivation, rather than *focusing* techniques to identify an area of interest, which may be necessary in a more general health appointment setting.

Brodie and colleagues (Brodie & Inoue, 2005) also examined the utility of MI within populations with chronic conditions. Participants with chronic heart failure were assigned to either MI, a standard care condition or a combination of both, and they identified that the MI and combined treatment group had significantly higher activity levels at post-treatment, whilst the standard care group did not. Therefore, MI may be a viable method of supporting PA change in combination with existing treatments. The current study used only a single-group design and future studies to examine the effectiveness could benefit from adding a comparator condition, which will support evidence for its use in behaviour change beyond existing approaches to change conversations. Evaluations of an MI intervention for PA found significant improvements to activity, stages of change and social

support, particularly when two or more sessions were attended by participants, and the changes to theoretical behavioural determinants (stages of change and identified regulation) were predictive of the activity level change (Hardcastle et al., 2012). The current study utilised different determinants of behaviour from the COM-B model and identified that these were not complemented by improvements to activity level, although the current participant group were relatively active and meeting activity recommendations at baseline.

A systematic review (Howlett et al., 2019) examining PA interventions for healthy inactive adults utilised meta-regression methods to clarify techniques associated with intervention effectiveness. There were several BCTs including *Biofeedback, Demonstration of the behaviour, behavioural practice or rehearsal,* and *graded tasks* associated with post-intervention effectiveness. However, using subgroup analysis of follow-up timepoints, effectiveness was associated with *action planning, instruction on performing the behaviour, prompts or cues, behavioural practice or rehearsal, graded tasks, and self-reward.* Within the current study there was some overlap of techniques that were frequently coded as present; in particular, *action planning*, although the present study did not assess follow-up beyond the end of the intervention. Another systematic review (Hartmann-Boyce et al., 2014) examining the use of BCTs and other factors within weight management interventions, *social comparison* was associated with greater weight loss. However, the authors noted that intervention content appeared to have similar BCTs used despite differences in the level of detail provided for each. Further, this paper focused on interventions that addressed both PA and other behaviours (such as diet) and therefore it may not be possible to directly compare to PA-specific intervention techniques, and other meta-analyses have suggested MI is more effective when focused on a single outcome as opposed to multiple health behaviours (Armstrong et al., 2011).

Particularly within MI, issues in poorly reported intervention descriptions are limiting factors for practitioner and researcher use of published studies (Mack et al., 2020). The current study has reported the relevant TIDieR guidelines (Hoffmann et al., 2014) and in addition, use of the technique taxonomies adds additional confirmation as to the mechanisms of the intervention as applied to PA behaviour change. A meta-regression study from Michie and colleagues (Michie et al., 2009)

identified that self-monitoring in combination with at least one other technique appeared to significantly improve outcomes in a meta-regression of pooled PA and healthy eating behaviours. The current findings indicate that self-monitoring, of either behaviour or outcomes, was not frequently identified within Motivational Interviewing specific interventions for PA behaviour. However, the current study aimed to avoid suggesting or advising of techniques to change behaviour without permission, and participants did discuss use of self-monitoring without the formal recommendation of this from the interviewer. Additionally, the use of self-report measurement tools for following outcomes and changes to behaviour may have been utilised by participants as an informal monitoring technique although this was not the intention of these processes. Other potential contributing factors to statistical findings in the literature have been suggested as variation in the fidelity of the treatment, which has been commonly reported as an issue within MI literature as it limits researcher's ability to confirm what was delivered in practice (Armstrong et al., 2011; Jelsma et al., 2015). Within complex behaviour change interventions it is important to understand the context of the study as this may also be a relevant factor in the intervention effects (Tarquinio et al., 2015) and should be reported.

There are several important limitations to mention. Firstly, participants discussed other health behaviours within sessions that related to their PA, for example sleep. A broader focus on health behaviours more globally, rather than a pinpoint focus on PA, may be more appropriate due to the interplay between multiple behavioural domains. Secondly, this study used an immediate follow-up which may not have accounted for changes to PA following the third session of MI, and does not provide information regarding the longer-term effects of the sessions on this or the behavioural determinants. Thirdly, a majority of the sample were already meeting PA recommendations, and only one participant moved from the moderate to low activity group over the course of the study despite national lockdowns in the UK limiting access to gyms and public spaces and reducing the need for active commuting due to work-from-home requirements. The restrictions of lockdown likely impacted individual changes to behaviour and therefore data collection during the study period. Research during the initial period of restrictions suggested significant decreases to physical activity time in student populations who were meeting recommendations (Huber et al., 2020; Stockwell et al., 2021),

although previously inactive individuals appeared to increase their activity time and interest in activity (Ding et al., 2020; Huber et al., 2020). Additionally, the findings are not generalisable to the male population due to the majority (90%) of participants being female. This is a potential issue in the research study design, as population-level findings suggest that men are also typically not meeting recommendations for physical activity, although a greater proportion of males meet recommendations for physical activity levels (Sport England, 2023). Therefore, it is important to understand the reasons why men were not recruited to take part. It is possible that due to the recruitment processes focusing on University departments such as Psychology, and advertisements placed around the University campus, for example in gym locker rooms, libraries and social areas, were not seen by men who may wish to raise their activity levels. Placing the advertisements in areas that were more frequently attended by men may have improved this. Finally, participation resulted in course credits for students who were enrolled on the Undergraduate Psychology course, which had a high proportion of female participants.

For all determinants, scores appeared to increase over time with two exceptions. The social support determinant decreased between sessions 2 and sessions 3. Physical opportunities to participate in change also decreased between sessions 1 and 2, although this returned to baseline in session 3. These items may be accounted for by changes in the social environment in which the study was conducted. Therefore, whilst PA did not appear to increase significantly, participants were able to maintain their existing levels. The impact of COVID-19 lockdowns in 2020 greatly affected data collection and many participants refocused their behaviour or outcome goals and this also impacted on recruitment as entry to the study was paused for new participants and also amended the mode of delivery for some sessions (from in-person to telephone-based). However, the mode of delivery in behaviour change interventions does not appear to impact on effectiveness (Samdal et al., 2017). The recruitment pause resulted in the data being underpowered for planned regression analyses. This meant that the statistical analysis to identify which techniques and how much variance contributed towards behaviour change could not be conducted. Finally, future studies could utilise alternative methods of PA measurement (such as activity sensors or trackers) as the self-report questionnaire used

required 7-day recall and self-report may provide an overestimation of true activity levels (Lee et al., 2011) although it was convenient for participants and easy to implement in the current study.

Within the current study there was no significant increase to PA; however, the sample was small, and the participants generally met recommendations for PA at baseline, suggesting a potential ceiling effect. This is important to consider in light of research suggesting that the positive health impact of increased physical activity is stronger when individuals are participating in higher levels (>150 minutes) of moderate to vigorous activity (Physical Activity Guidelines Advisory Committee Scientific Report., 2018). Future research could limit recruitment to individuals who were insufficiently active in line with recommended activity levels. Additionally, participants within the study had an average BMI within recommendations (mean of 22.86, ranging from 19.57 to 30.96 kg/m^2). Future research could target individuals meeting classification criteria for overweight and obesity, in order to assess the utility of the intervention in samples that would gain health benefit. Although the current study did not utilise exclusion criteria of BMI, research (Dombrowski et al., 2010) has pointed towards a beneficial effect of physical activity for individuals living with overweight and obesity when utilised within interventions targeting multiple behaviours. Therefore, revisions to the study recruitment processes, for example study advertisements, may positively impact on the recruitment of individuals with BMI scores that are considered to be representative of overweight/obesity and associated increased risks to health (Avila et al., 2015; Bhaskaran et al., 2014). It is possible that the study advertisement, which aimed to attract individuals with an interest in making changes to their physical activity levels, did not appropriately target those who would benefit from increasing their current activity levels. Additionally, interventions that are designed to focus solely on physical activity increases are associated with modest initial weight loss and require intensive input from interventionists, although it is a predictor of weight loss *maintenance* in interventions that address multiple health behaviours (Sniehotta et al., 2019). Therefore, interventions that target multiple behaviours, for example both physical activity and eating behaviours, may be more successful at producing health benefits in the long term.

Due to the impact of national lockdowns, the study experienced difficulties with recruitment and retention of participants. Recruitment was closed early due to the first national lockdown and recommendations to reduce social contact. Therefore, whilst it was expected that the study would recruit more widely, study recruitment was only initiated within the University Psychology department. This meant that a smaller number of participants were recruited to take part in the study, and participants were advised that they could exit the study. As participants were recruited primarily from the Psychology department, they were awarded course credit for taking part. This course credit requirement was waived upon the announcement of the national lockdown as students returned to their home addresses and were therefore unable to complete the study sessions.

However, this study was able to provide additional support for use of specific techniques developed for clarification of the content of MI interventions and identified that the techniques intended to support engagement within behaviour change conversations were particularly frequent in an MI approach. BCTs related to *goals and planning (action planning, behaviour goal setting,* and *review of behavioural goals)* in the taxonomy were most commonly occurring. Assessment of the presence or absence of techniques across individual-participant level data found that BCTs *identification of self as a role model, reframing, behavioural commitment* and *social comparison* had effectiveness ratios of >80%. MI techniques *Permission to provide information, looking back, overshooting, undershooting* and *shifting focus* had effectiveness ratios of 100%, but must be interpreted with caution as they were present in a minority of audio sessions. Conversely, *query extremes, support change/persistence, importance ruler,* and *looking forward* had effectiveness ratios of <50%. Use of a larger sample of recordings, and analysis involving multiple individuals delivering MI would be appropriate to provide an understanding of technique effectiveness that is grounded in practice.

To summarise, this study utilised an MI approach to investigate its effectiveness for physical activity behaviour change and the determinants of that behaviour. There were no significant changes to participant's activity levels from baseline to the third session. However, there were significant changes increases in behavioural determinant scores. This improvement suggested a raise in

189 participant's self-reported capability, opportunity and motivation to engage in the behaviour; however,
190 it was not matched by their activity levels. Future studies could utilise a longer-term follow-up to
191 investigate if the behavioural determinant scores maintain their level over a longer period of time.
192 There were similar BCTs present as identified in other coding-based studies of MI, and the most
193 frequent MI-specific techniques fell into the evoking and planning categories.

194

Chapter 6. Protocol for a randomised controlled feasibility trial: Investigating a Motivational Interviewing approach to weight-related behaviour change for adults with obesity.

Foreword

The findings of Chapter 5 suggested that MI may be an effective intervention to support changes to the determinants of behaviour within a sample of adults desiring to change physical activity behaviour. MI is an autonomy-promoting approach that may be beneficial for adults living with obesity with an interest in making bodyweight-related behavioural changes. This chapter reports the planned research methods for a randomised controlled feasibility trial. The trial intended to recruit 30 adult participants with Body Mass Index $\geq$30.00 kg/m^2 to one of two arms (intervention; control) using computerised randomisation methods through the Qualtrics website. Due to the nature of the intervention delivered through contact with the research team, participants and research team members were unblinded to allocation but outcome assessment will be conducted via anonymised electronic self-report. The intervention group received up to 3 one-hour individual Motivational Interviewing sessions using video calling software or telephone methods as preferred. The control group received a time-matched video providing general advice about current recommendations for nutrition and physical activity for adults, delivered by the interventionist in a lecture-format. The trial intended to assess the feasibility of research methods of recruitment, randomisation and allocation. Secondary objectives were to (i) investigate the effect size of the intervention for achieving desired behavioural change, (ii) to identify the content of MI sessions using pre-existing taxonomies of behaviour change and MI-specific techniques, and (iii) to investigate potential mechanisms of action related to intervention effectiveness. This chapter presents the study protocol.

1. Introduction

Obesity is classified as the accumulation of excess bodyweight and is increasing in prevalence worldwide (Bray et al., 2016; World Health Organisation, 2021). Frequently diagnosed through the use of physiological assessment such as Body Mass Index (BMI), it is believed to hold serious implications for future health outcomes including increased risk of noncommunicable diseases such as hypertension, cardiovascular disease and Type 2 Diabetes when compared to populations without obesity (NHS, 2019). The root cause of obesity is complex and multifactorial (Perriard-Abdoh et al., 2019), and even if initial weight-loss is successful, maintenance can prove challenging (Barte et al., 2010; Wing & Phelan, 2005). Genetic, environmental, social and behavioural contributors to obesity work in tandem and a require evidence-based, effective, and implementable interventions to support the reduction of risk to health (National Institute for Health and Social Care Excellence, 2014).

Individuals will experience a range of contributory factors that lead towards the accumulation of excess bodyweight. Frequently, modern living offers a reduction in physical activity and increase in sedentary activity time due to desk-based working, motorised transport, and built environments that provide easy access and frequent advertising to energy-dense, palatable foodstuffs which in some instances may be much more easily accessible than other, lower-energy, high-nutritional options (Townshend & Lake, 2017; Coates et al., 2019) and the prevalence of sitting-based leisure activities such as television and computer games. We develop our eating behaviours through early life experiences and may come to learn our behaviours and preferences for food and activity (Kelly et al., 2016). There may also be a genetic component indicating that to a point, obesity can be heritable (Friedman, 2009).

Individuals with obesity may also experience weight bias and stigma in their everyday life and healthcare treatment settings which is associated with adverse impacts on physiological and psychological wellbeing, with reduced self-esteem and increased anxiety and depression (Puhl & Brownell, 2006; Wu & Berry, 2018). Qualitative research about the use of terminology within weight management has reported that individuals have no unified preference on how to best address the

matter of adiposity, and that a sensitive and individualised approach should be taken to support patients when discussing overweight and obesity (Gray et al., 2009).

Obesity develops through a complex interplay of our experiences and biology, requiring well-designed and specialised treatment to resolve the health issue. Obesity care can involve the use of bariatric surgery (Gloy et al., 2013), pharmacological medications for the suppression or modification of appetite and intake of nutrients (Padwal & Majumdar, 2007), and therapeutic and behavioural change interventions that can address weight-related behaviours, such as physical activity or eating behaviours (Perriard-Abdoh et al., 2019). Specific components of non-surgical intervention, such as techniques of self-regulation such as self-monitoring of progress, feedback on performances, and goal setting appear to be effective for supporting the maintenance of initial weight loss (Simpson et al., 2012). Weight loss maintenance seems to be particularly challenging (Greaves et al., 2017), as it requires long-term changes to diet and activity to increase chances of maintenance success without surgical intervention (Wing & Phelan, 2005). Currently, bariatric surgery offers beneficial outcomes for weight loss maintained over time, but also requires changes to behaviour to maintain its benefit (Nguyen & Varela, 2017). It is necessary to identify the core components of effective behavioural interventions that can be used to support weight loss outcomes. To be able to develop and manualise such interventions to ensure effectiveness, it is necessary to know precisely what is occurring within successful weight management interventions. A taxonomy of active ingredients that can be used to summarise intervention content has been published (Michie et al., 2013).

Due to the multiple causal factors and its complex nature, obesity requires interventions that can address its intricacies and individualised situations. Motivational Interviewing (MI) (Miller & Rollnick, 2013) is one such approach to counselling and communication intended to support an individual in resolving any ambivalence about making changes to behaviour. It is a complex intervention (Hardcastle et al., 2008) that can include many different components and techniques (Hagger & Hardcastle, 2014; Hardcastle et al., 2017) and requires an empathic understanding of contextual factors to resolve discomfort with the desired behaviour change and collaborate for planning of the next steps. Generally, MI is a patient-centred, goal-directed manner of communication

that promotes the autonomy of the individual in deciding the actions they wish to take and empathy for their situation and strengths. There are several key processes utilised within conversations using an MI approach (Miller, Rollnick, 2013); *engagement* with the individual, to create an environment where they feel comfortable to converse freely; *focus* on the specific area of interest to change; *evocation* of reasoning in favour of the action; and *planning* of specific steps to work towards their goals. The practitioner is working in *partnership* with, rather than enforcing reasons and ways to behave onto the participant using open questions, affirmations, and selective reflections of the individual's contributions alongside other content-based and relational techniques outlined by Hardcastle and colleagues (Hardcastle et al., 2017). MI is evidence based in multiple fields (Lundahl et al., 2010) and utilised in health settings such as paediatric care (Gourlan et al., 2013; Dawson et al., 2014), risk-taking behaviours in young people (Sanci et al., 2012), dentistry and health promotions (Curry-Chiu et al., 2015; Martins & McNeil, 2009) and adherence to other interventions (Hill & Kavookjian, 2012; Smith et al., 1997). MI may be beneficial for weight loss within obesity and overweight care settings as it provides a person-centred, non-judgemental approach which can structure treatment conversations to the interests of the patient. However, exact mechanisms of action for why MI may be beneficial are currently unclear despite multiple hypothesised routes of action including patient-focused behaviours like increased elicitation of change talk and softening of sustain talk, the interpersonal relationship between practitioner and patient and use of technical components such as open questions and reflections (Apodaca & Longabaugh, 2009; Magill et al., 2018, 2019). Reviews of the evidence base have provided some support for the change talk hypothesis and the MI spirit (Copeland et al., 2015). This refers to the relational aspect of the practitioner's approach to the consultation as a partnership and evocation of ideas about change rather than imposing instruction for what steps to take next (Miller & Rollnick, 2013).

A definitive trial to establish the effectiveness of MI interventions for weight-related behaviour change is necessary as a recent review (Makin et al., 2021) outlined mixed evidence in support of MI skill use with individuals with obesity for adiposity outcomes of bodyweight in kilograms or BMI. However, MI intends to address behavioural changes such as changes to eating

behaviour and physical activity. Therefore, it is necessary to clearly evaluate the impact of MI on *behavioural* outcomes, as opposed to adiposity-based outcomes. However, such an intervention will require clearly outlined research methods such as how participants will be recruited, how and what components will be delivered in the intervention, and feasible assessment measures (Medical Research Council, 2019). The current trial is designed as a feasibility study to investigate if methodological components are appropriately designed, and additionally, as a component of work submitted towards a PhD qualification; to estimate the potential effectiveness of the intervention and variance in outcome measures that could guide a future power calculation; and indicate possible mechanisms of action that should be pursued in a larger trial.

Specific research questions

- How feasible and acceptable are the recruitment processes, intervention delivery and retention of participants to a Motivational Interviewing research trial for weight-related behaviour change in the context of obesity? Are there any changes to be made in preparation for future trials?
- [Exploratory] Is Motivational Interviewing likely to be an effective individual intervention for weight-related behaviour change in an adult sample with obesity in comparison to the provision of information?
- [Exploratory] What are the relational and technical factors present in successful individual-level Motivational Interviewing interventions for weight-related behaviour change in a sample of adults with obesity?

2. Methods

2.1. Trial design

The study compromises a two-arm, individually-randomised controlled trial which will run over a 12 week period (approximately a 6 week intervention period and a follow-up assessment at 12 weeks post-randomisation). Methods reported are in line with the CONSORT checklist (see Appendix materials). Participants will be randomised (1:1) to the intervention or control arm by a computerised

323 random allocation process via Qualtrics (www.livpsych.eu.qualtrics.com). Self-reported surveys will
324 collect data regarding process and core outcomes for obesity trials (Mackenzie et al., 2020); see below
325 for full details.

326 ## 2.2. Recruitment methods

327 Participants will be recruited to start dates over two blocks in 2020: Wednesday 19th October to
328 Friday 20th November, and Wednesday 9th December to Wednesday 18th December. A third block will
329 start in January 2021. Participants who are able to start in block 1 or block 2 will begin their
330 involvement with the study at these times. Participants who are unable to start before December 2020
331 will join a wait-list, and be re-contacted in January 2021 by study team members.

332 Participants will be recruited from public advertisements in community areas such as
333 libraries, coffee shops, cafes, gyms, and local shops, and social media (Facebook, Instagram, Twitter)
334 and through contacts such as patient advocacy groups and expression of interest in future studies from
335 previously conducted research. The recruitment advertisements contain the contact details (email and
336 telephone number) of the research team for interested individuals to contact for more information.

337 Following contact, the researcher will provide the participant information sheet and answer
338 any questions. After a two-working day period, the researcher will contact the interested individual
339 again to follow-up on any queries and ask if they would like to participate. If there is no response, the
340 individual will not be contacted again. If they would like to take part, the researcher will send a link to
341 the Qualtrics site hosting the screening survey, baseline assessments and randomisation. Participants
342 will consent to meeting the inclusion criteria, and responses to demographic questions will screen to
343 confirm they meet inclusion criteria. Participants who indicate on the brief screening questions that
344 they do not meet inclusion criteria will automatically be redirected to the debrief page without
345 completing baseline measurements or being randomised to the intervention or control arms of the
346 study.

To facilitate participant recruitment, contact details and a date of last contact will be stored on a secure, password protected file accessible only to the study members. This is necessary to ensure that queries are followed up appropriately and in a timely manner.

2.2.1. Eligibility criteria

Table 11. Eligibility criteria

Inclusion criteria	Exclusion criteria
Have a current BMI of 30.00 kg/m^2 and above according to widely-available NHS formula calculators (https://www.nhs.uk/live-well/healthy-weight/bmi-calculator/)	Current BMI of 29.99 kg/m^2 and below
Have a current interest in changing a weight-related behaviour, for example eating behaviours such as snacking, or physical activity behaviour such as sports, gardening or walking, or other behaviour related to weight like seeking guidance, social support or further information	No interest in changing weight-related behaviours
Not have any medical conditions which may impact on your ability to make changes to the desired behaviour	Health conditions that will limit ability to change the desired behaviour
Be willing to take part in up to 3 x 60 minute, individual sessions with a researcher discussing their desired behaviour change	Unable to take part in the research sessions if allocated to the intervention condition or control group

2.3. Setting and locations

Participants who are based in the UK will be recruited to the study. The intervention will be carried out in a research space at the University of Liverpool or, in the case of national/local lockdown or participant preference, remotely via video calling apps such as Skype, Microsoft Teams and Zoom, or telephone. The researcher will be based at the University offices or home-working with University software (Zoom and Teams under University license, and remote access to University M drive). Participants will complete the intervention session (up to 60 minutes) and then be asked to complete

the post-session survey on their own devices. Reminders of their ID number will be sent via email at baseline, two weeks later, 4 weeks later, and 12 weeks later. Therefore, participants will be required to have access to an internet-enabled device to take part in the study. Individuals allocated to the control group will not be required to attend the University to complete sessions. Participants are to be advised that the study materials are best completed in a quiet environment without disruptions and with adequate time to take part (approximately 40 minutes for the video, and 10-20 minutes for surveys).

2.4. Sample size

Formal sample size calculations were not conducted as the study is intended to assess feasibility of the recruitment methods and delivery of the intervention and control group content rather than effectiveness of the intervention. Further, the intervention delivery was led by one PhD researcher (HM). Pragmatic assessment considered that with up to three hours per intervention participant, 30 participants in each arm (60 participants total) was an acceptable number to recruit. Effect sizes from the current study may be utilised for sample size calculations for future trials. A review of sample sizes of pilot and feasibility studies (Billingham, Whitehead & Julious, 2013) found that feasibility trials ranged from a total of 10 participants to 300 participants (median = 36 per arm) at outset and finishing with a range between 8 to 114 participants for trials with a continuous endpoint. For feasibility studies, there are mixed recommendations within the literature (Hooper, 2019). A minimum of 12 participants per group is recommended by some researchers (Julious, 2005). An overall sample size of 30 or more *may* be sufficient for calculating power of the trial and future sample size calculations (Donald, 2018, Lancaster, Dodd, & Williamson, 2004, Browne, 1995). To account for potential dropout, if we identify 60 eligible individuals to take part, it will be possible to estimate a participation rate of 50% to within a 95% confidence interval of +/- 12.52% (using formula from Hooper, 2019).

2.5. Randomisation

2.5.1. Sequence generation

Participants will be randomly allocated by the Qualtrics software. All participants will complete the same set of screening questions to confirm eligibility and collect demographic information, and the same baseline measures. Qualtrics will then utilise the block randomization tool to display either the control group content or a debrief message page for the intervention group, which will email the research team with their email address and telephone number to arrange the intervention session. Randomisation on Qualtrics is set to provide roughly equal allocation to each arm of the study. The research team have no control over allocation to conditions, as this is completed by the Qualtrics software tools.

2.5.2. Allocation and concealment

Allocation concealment refers to ensuring that the allocation of participants is not known to the interventionists, outcome assessors or participants. Concealment of allocation reduces biased estimates of the treatment effect. Due to the nature of the study, it is not possible to completely blind participants or research study team members to the allocation of participants - it will be necessary to communicate with participants about when to arrange their intervention sessions, and participants allocated to the control group will be fully aware they are not receiving a 60-minute individual session with a researcher. However, allocation will be carried out by the Qualtrics software without input of the researchers. To reduce influence of the researcher on outcome assessments, these are completed by the participant, away from the researcher, using an anonymous ID number to link their responses together. To investigate if random allocation was successful, baseline characteristics of each group will be presented within the written report to allow inspection of any differences between the groups. However, statistical significance testing will not be used as this is considered inappropriate for randomised control trials (Altman & Doré, 1990). For concealment of allocation from outcome assessment risk of bias is low as outcome data is collected electronically via self-report.

2.5.3. Implementation

Due to the nature of the intervention, it is not possible to blind the participants to their allocation. They will be fully aware of the condition they are allocated to as it involves contact with a researcher rather than the provision of general information. Further, the interventionist will be aware of their allocation. Use of Qualtrics email triggers reminding them of their ID number will allow for participants to be invited to each follow-up without involvement of the researcher. However, as the intervention condition may not fall at precise two-week intervals (for example, arranging for a session 13 or 15 days later rather than 14), the researcher will send the link for data collection to them directly. Outcome assessments will be completed by self-report, and each timepoint response will be linked at study completion once all data has been collected by the random ID number chosen by each participant. Data on completion rates will be reported (see Analysis plan).

2.6. Arrangements for informed consent and right to withdraw

All participants taking part in the study will provide informed consent. Individuals who decline to provide consent will not be able to take part. Participants will be fully informed of the study procedure through the information sheet and consent form and will be provided with contact details for the research team if they have any queries. Participants are informed through the information sheet that they may withdraw from the study at any time point until analysis, without providing any reason and without detriment. If participants wish to withdraw from the study, they can exit the study by closing their web browser. Participants who do not respond to contact will be emailed by the research team on two occasions before being presumed withdrawn.

Participants will also be advised that if they would like to withdraw their previously completed study data, they should contact the research team and inform them, or follow the ‘reasons for withdrawal; survey link provided at each email prompt. They do not need to provide a reason for withdrawal but providing the research team with details such as their 5-digit random ID number and date of survey completion will enable the researchers to locate and remove their data prior to analysis.

2.7. Loss to follow-up

This study involves multiple time points of data collection and study involvement, which may result in participants opting to not complete or attend sessions. To improve retention of participants, the sessions can run entirely remotely using video calling tools such as Zoom and Microsoft Teams. The control group content is hosted on the Qualtrics site entirely. For both arms, the sessions can be arranged at a time of the participant's choosing - for the intervention group, they will be asked when a suitable date and time for the face-to-face session would be, and the control group will receive a link to follow. This means that both arms of the trial can be completed at a location convenient for the participant, at a time that works for them. Additionally, piloting of the surveys indicates a response time of around ten minutes which was considered acceptable by those completing piloting (other researchers working in different areas, and laypersons with no formal qualifications in research or Psychology). The intervention participants will be advised that they do not have to speak for the whole scheduled session (60 minutes) and can end early if they consider this to be most useful. To reduce attrition, the control group will be able to click through without watching the whole video to the survey page. For both arms, the duration of sessions will be recorded to provide descriptive information on engagement.

For participants in the intervention group, we will attempt contact to rearrange missed sessions twice before considering the participant withdrawn. Participants will be sent links to complete the outcome measures at the expected timepoints (post-session 2, post-session 3, and 12-weeks post-baseline) unless they request withdrawal from outcome assessment. For participants in the control group, if they do not respond to up to 2 emails asking them to take part in the next timepoint within 2 weeks they will be considered withdrawn. Participants will only receive an email inviting them to complete the next session or follow-up if they view the final set of survey questions in the present session, i.e., participants who close their browser during the initial baseline measures in session 1 will not be emailed to complete session 2, session 3, and the 12 week follow-up.

At the bottom of reminder emails participants will be able to follow a link to a short survey where they can inform the research team they would like to withdraw and provide a reason for this.

They can opt to continue to complete surveys without attending sessions. The research team will be forwarded their email address by Qualtrics and they will be manually sent a 12-week follow-up survey to complete. They can also provide their unique ID number if they wish to withdraw all their data prior to analysis.

2.8. Procedural overview

Participants will be sent a link to a Qualtrics page, which hosts the information sheet, consent form, baseline survey, randomisation, and session 1 content for the control group. The baseline survey includes a short screening questionnaire which confirms eligibility to participate and collects participant characteristics data. Additionally, participants are requested to create a random 5-digit ID number, which they are asked to provide at each survey. Following the completion of data collection their ID numbers will be used to link responses together. Qualtrics will send the participants a reminder of their ID number following completion of the survey and at each invitation to the next session. All ID number reminders are issued by Qualtrics email triggers and the participant's ID number is not known to the research team. Participants will complete the survey at baseline, post-session 2, post-session 3, and 12-weeks post-baseline.

Participants will then be randomised 1:1 using Qualtrics 'block randomizer' tool. This will randomly display either the intervention group or the control group material to the participant. For those in the intervention group the email address provided will be automatically sent to the researcher to arrange the first intervention session. The participant will receive an email with the random ID number they created during screening. The control group will receive automatic emails two weeks after viewing the control content asking them to complete the next session. See Figure 1 for timepoints.

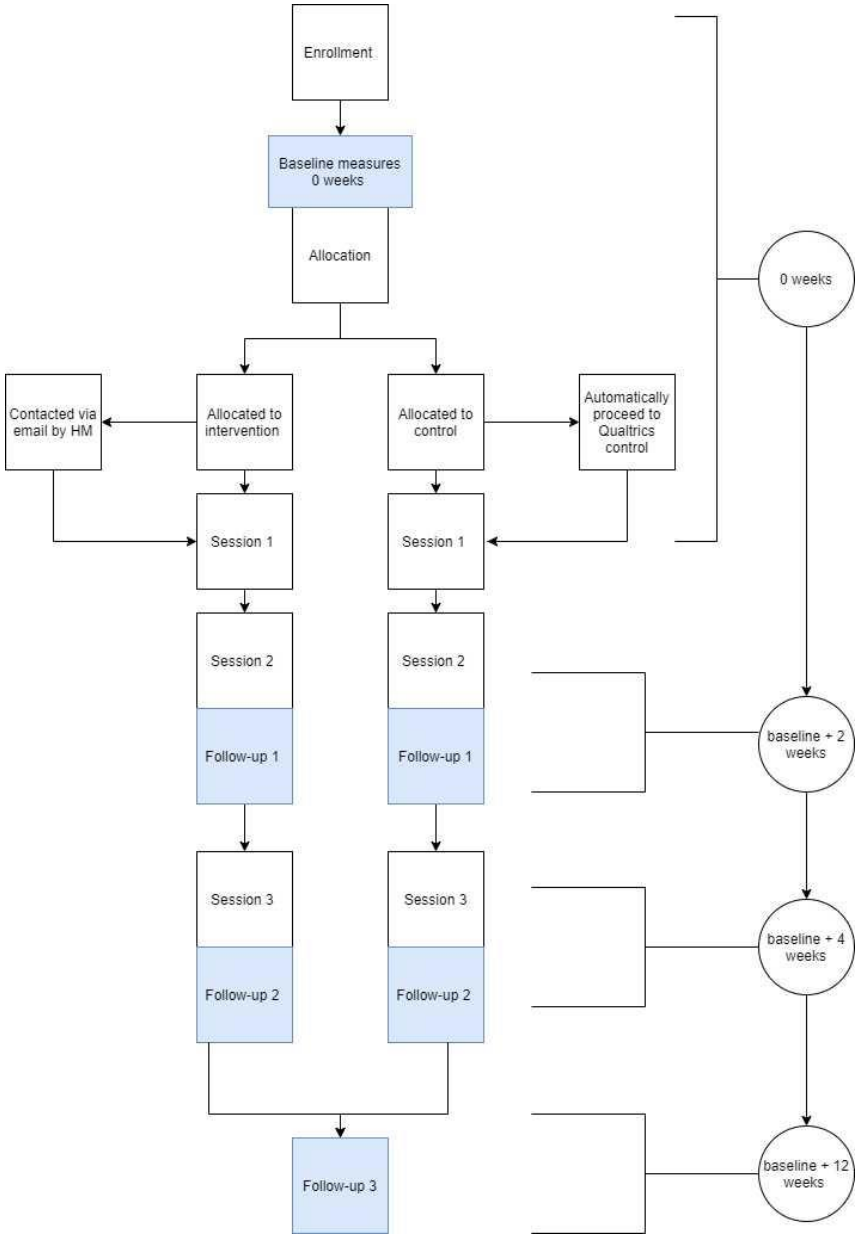


Figure 12. Timepoints of sessions and assessments.

2.9. Surveys

Participants will be asked to self-report demographic characteristics (*age; sex, BMI; general behaviour change of interest, indication of previous discussion with healthcare professionals about obesity, pre-existing health conditions*) at baseline. These also act as screening measures and reduce the number of questions that need to be completed; participants who provide responses that do not

meet eligibility criteria will be automatically redirected to the debrief and thank you page, without being randomised to either arm.

At baseline, post-session 2, post-session 3, and 12-week follow-up, participants will be asked to complete validated measures that investigate current eating behaviour (Ruddock et al., 2017) current physical activity (Craig et al., 2003) a 5-item self-report measure of current wellbeing (World Health Organisation Regional Office for Europe, 1998, Topp et al., 2015) behavioural determinants (Keyworth et al., 2020) and an unvalidated one-item behaviour change rating scale. An unvalidated measure of behaviour change rating is used as it provides an indication of how successful participants considered their behaviour change actions to be and can be completed quickly. Participants are also asked to provide rationale in a free-text box for their response. Early piloting of the study surveys with a small sample of external researchers and laypersons indicated all measures were readable, clear and took approximately 10-20 minutes to complete. At 12-week follow-up only, participants will additionally provide a measure of their current bodyweight along with the outcome measures.

2.10. Procedure

2.10.1. Intervention

Participants randomised to the intervention will be invited to arrange a one-to-one, 60-minute session with the researcher (HM) initially by email, although if there is no response this will be followed up via telephone. Qualtrics will send the email address and telephone contact number of the participant to the researcher upon allocation to this arm. The second session will be arranged at the end of the first meeting to take place approximately two weeks later at a time convenient for the participant. At the end of the second session, the participant will be emailed a link to the Qualtrics questionnaire for timepoint 2 measurements, and the third session will be arranged. Following the third session, the participant will be emailed a link to the Qualtrics for session 3 measurements. Qualtrics will automatically send an invitation email to complete the 12-week follow-up to the participant, along with a reminder of their random ID to permit linking of data from each timepoint.

Intervention sessions will be delivered by one Psychology PhD researcher (HM) who has received beginner and intermediate level workshops about MI practice, online modules with the BMJ, and has conducted research within MI topics for the previous 3 years. They have also undertaken MI supervision sessions with a Motivational Interviewing Network of Trainers (MINT) registered MI trainer and during the project will undertake regular supervision with a HCPC registered Health Psychologist after every 3 sessions. Additionally, the researcher has attended training in relation to obesity and research practice such as the European Association for the Study of Obesity's New Investigators United workshop, attendance at EASO conferences and ongoing training through UKASO webinar series. The content of the sessions is developed in line with what the participant considers to be important areas or topics of interest to their desired behaviour change. This is expected to be related to their physical activity or eating behaviours such as snacking, or other plans such as seeking further support or advice from elsewhere. The researcher will use open questions, affirmations, complex/simple reflections of the participant's responses and summary statements to discuss the ambivalence that the participant may feel towards their behaviour change and work towards shaping goals. A key component of MI is that the approach promotes autonomy and empathy; the researcher will not provide information without permission but will provide general advice in line with current UK and NHS guidelines for physical activity and eating behaviour in adults when requested or with the permission of the participant, with the caveat that participants should speak to their GP prior to changing any existing routines. No medical advice will be provided, and participants will be advised to contact their GP for any health concerns. Any behavioural goals or outcome goals will be directed by the participant's own interests and the researcher will intend to elicit their reasons for change, rather than imposing or instructing on the direction of their behaviour change.

Sessions will be audio recorded using a Dictaphone or, in the case of remote-running sessions, recorded through the software used to run the session (e.g., Zoom audio recording). Video recordings will not be used. All audio recordings will be stored on the University M drive in a password protected folder, and labelled with an ID number that protects the participant's anonymity, session number and session date (e.g. PPTID_01_S1_021020, PPTID_02_S2_111220). Audio recorded on an

external Dictaphone or personal laptops will be moved onto the University M drive as soon as possible following the session and deleted from the device.

2.10.2. Control

To provide a time-matched control condition, participants allocated to this arm of the trial will complete baseline measures at the same timepoint as the intervention group and will complete the control condition immediately. The control condition is composed of a video providing information about current UK guidance for dietary intake and physical activity levels for adults. The duration is approximately 35 minutes, a similar duration to the mean length of face-to-face sessions during an earlier study addressing physical activity related behaviour change using an MI approach (38 minutes average). The information is delivered in a lecture-style, didactic format by the same researcher who provides the intervention condition. Information was collected from a range of evidence-based, governmental or charity resources, for example the National Health Service webpages about recommended nutritional intake (food groups, tips for changing eating behaviours, information about recommended calorie intakes) and recommended activity levels (definitions of vigorous, moderate, sedentary and walking activity, suggestions for increasing light activities) before being summarised for short segments of video. Initially, the video covers information about the research study from the information sheets and the participant's right to withdraw. The video then covers the topic areas before providing a general summary of the key points of each topic, requesting the participant check their emails for invites to the next session, and providing the research teams contact details for any queries. Whilst participants will have the option to click to proceed through to the end of the session, the duration on the page will be recorded. Qualtrics will send an automatic email two weeks following the video with a reminder of their random ID number and inviting them to take part in the second session. The second session involves the control video and completing the same outcome measures as the intervention group. The third session and follow-up session will be arranged in a similar format. All emails will also contain a link to a short questionnaire providing information about the right to withdraw, reporting of reasons for choosing to withdraw, and informing participants that they can

choose to end their participation in the active study sessions but continue to provide outcome assessments if they wish.

2.11. Monitoring intervention delivery

To monitor the delivery of the interventions, several steps will be in place. Firstly, there will be regular supervisory contact between the researcher delivering the intervention (HM) and the PI (AC) after every three sessions to reflect on practice and skills. This will include meetings to recap over how the sessions are going and highlight any issues surrounding delivery early on. Meeting notes will be recorded. Any issues that arise during the data collection period will be highlighted with the PI immediately.

Additionally, use of a tool to assess the fidelity of Motivational Interviewing (the MITI; v4.0, (Moyers et al., 2016)) will be used. This will be used by the researcher delivering the intervention to code all sessions with the tool and determine how the intervention has been implemented whilst adhering to the ethos of the approach, as well as highlighting the use of techniques such as reflection and open-ended questions. Approximately 25% of audio will also be coded by an external evaluator who has received MINT [https://motivationalinterviewing.org/] training to use the MI and is a practitioner and supervisor in a health-related field. 25% will be coded by a member of the research team. The remaining 50% of sessions will be coded by the researcher delivering interventions (HM). See Appendix for budget outlines (Appendix p).

2.12. Outcomes

Outcomes map onto the core outcome set for reporting of obesity interventions (Mackenzie et al., 2020). As MI intends to address behaviour, and it is unlikely to see significant changes in measures of bodyweight or BMI within a short timeframe as indicated in the current study, these outcomes are not assessed. Bodyweight data will be collected through self-report measures at baseline and 12-week final follow-up. However, process and optional outcomes will be collected (retention of participants and reasons for withdrawal, data related to physical activity and eating behaviour, wellbeing, behavioural determinants and self-reported behaviour change achievement).

2.13. Planned analyses

2.13.1. Primary research question examining feasibility of the trial: outcomes

The recruitment processes will be documented by providing information of the numbers recruited through methods of online social media advertisements, contacts with interested stakeholders and local advertisements. The proportion of participants who were eligible and ineligible to take part will be reported. Additionally, the implementation of randomisation procedures will be reported, as well as use of procedures to reduce risk of bias, such as anonymous electronic outcome assessments. We will report on if randomisation procedures were successful. The retention rates of participants and completion rates of study surveys (% of participants retained; % of participants completing 100%, 80%, and 70% of all possible survey sessions) will be reported to determine if the trial and measures utilised are feasible and appropriate for use within a trial addressing the use of MI as an intervention for weight-related behaviour change in obesity care. Data on the number of ineligible participants excluded at screening stages and drop out will be reported through participant flow diagrams. This will assess the timings and completion of participants involved in the control group, who received automatic email prompts to complete sessions and surveys. Participants who no longer wish to take part in the study will be invited to provide written reasons for drop-out.

2.13.2. Secondary research questions examining the effectiveness and content of the intervention: outcomes

Analyses will investigate the effect of the intervention on self-report behavioural achievement measure at 12-week follow-up as a primary outcome of effectiveness which will be used for future power calculations. This is measured using an unvalidated, single-item measure of behavioural achievement, which states, "*In relation to the change I wanted to make…"* and invites participants to select a number on a sliding scale from -100 to +100. At either end of the scale, a prompt states, *"I have done a lot less than what I wanted to do"* and *"I have done a lot more than what I wanted to do."* On the scale, 0 is prompted as representing *"I have done exactly what I wanted to do."*

Participants are also invited to complete a free-text response box that states, *"please could you tell us a bit more about whey you provided this answer?"*

Additionally, the effects of the intervention on physical activity, eating behaviours and wellbeing at 12 weeks will also be described using pre- and post-descriptive statistics within group differences, and Cohen's d effect sizes to examine trends between-group differences. Effect size cut-offs of 0.2, 0.5 and 0.8 will be used to suggest small, medium and large effects.

The contents of the intervention will be examined using predefined measurement tools for treatment fidelity (MI Treatment Integrity scale; MITI 4.0; (Moyers et al., 2016), the recently defined MI-specific techniques (Hardcastle et al., 2017), and the Behaviour Change Techniques Taxonomy (BCTTv1; (Michie et al., 2013). This will be carried out by one researcher (HM). 25% of sessions will also be second-coded by a researcher outside of the research team who has received training to use the BCTTv1. Inter-rater reliability scores will be calculated as Cohen's kappa and prevalence-adjusted bias-adjusted kappa scores (Byrt et al., 1993, Cohen, 1968). All sessions will be coded.

2.14. Statistical methods

2.14.1. Descriptive statistics reporting

Descriptive statistics will be provided for demographics of the sample as a whole and within each group (age, sex, and BMI). Survey scores at each timepoint (baseline; post-session 1, post-session 2, post-session 3, 12-week follow-up) will be presented for the sample as a whole and within each group separately. Statistics reported will be mean and standard deviation for parametric data; non-parametric data will utilise the most appropriate equivalent e.g., median and range. Percentage of participants reporting a pre-existing health condition and prior discussion about obesity with a healthcare professional will be presented. In line with guidance from the CONSORT statement (Schulz et al., 2010) and recommendations from other literature within the field of nutrition and activity behaviours research (de Boer et al., 2015; Peterson et al., 2017), baseline differences will not be examined with significance testing. However, descriptive statistics will illustrate comparability of the groups.

2.14.2. Research question 1

How feasible is the recruitment processes, intervention delivery and retention of participants to a Motivational Interviewing research trial for weight-related behaviour change in the context of obesity? Are there any changes to be made in preparation for future trials?

The first research question addresses how feasible the recruitment processes, intervention delivery and retention of participants to a Motivational Interviewing research trial for weight-related behaviour change in the context of obesity. This will identify if there any key changes to be made in preparation for future trials to the methodology.

To investigate recruitment and retention, summary data of participant numbers will be reported in a flow diagram displaying retention and the number excluded at each stage will be reported. The % of participants retained and % of participants completing 100%, 80%, and 70% of all possible survey sessions will be reported. Provided reasons for drop-out will be summarised and reported. The delivery of the intervention will be considered using fidelity tool data (see below).

2.14.3. Research question 2

Is Motivational Interviewing an effective individual intervention for weight-related behaviour change in an adult sample with obesity in comparison to the provision of information?

The second research question addresses the effectiveness of the intervention for behaviour change outcomes. Due to the feasibility nature of the trial, no formal calculations of power were conducted which may result in underpowered results for statistical testing.

Within and between group differences and effect sizes for pre- (baseline) and post-session (12-week follow-up) change scores will be reported (adjusted for covariate) for physiological measures (BMI), behavioural determinants, physical activity, eating behaviour, and wellbeing measures.

However, as a component of HM's PhD thesis in Psychological Sciences an analysis of covariance (ANCOVA) will be run using SPSS software (v26 IBM, 2020). 95% confidence intervals

and appropriate effect sizes will be reported. The independent variable will be group assignment (categorical variable; intervention or control group dummy coded as 0/1). The dependent variable will be the single-item behavioural achievement measure (visual analogue scale of -100 to +100). Baseline ratings of behavioural achievement will be included as covariates. The baseline measure may differ between groups despite random allocation to arms, which may result in regression to the mean effects. In turn this can influence the overall treatment effects and display an increase in the final measurement scores of groups scoring lower at baseline, or a decrease in the scores of higher baseline measurement groups, i.e., over or underestimation of effects. Controlling for the baseline is recommended practice within trial research (Twisk et al., 2018).

2.14.4. Research question 3

What are the relational and technical factors present in a Motivational Interviewing individual-level intervention for weight-related behaviour change in a sample of adults with obesity?

In addition to providing evidence of whether the intervention is effective at supporting behaviour change within the sample, it is important to clearly understand what components are involved within the MI sessions that may account for effectiveness. An exploratory research question will investigate what relational and content-based factors and techniques of a Motivational Interviewing were present in the individual-level intervention for weight-related behaviour change in a sample of adults with obesity. To address this, we will examine the content in terms of fidelity to Motivational Interviewing concepts and ethos, and through coding the content of the sessions for techniques, as outlined below.

2.15. Fidelity assessment

To assess fidelity of the MI sessions, a random 20-minute segment from recordings in session 2 and recordings in session 3 will be assessed using the Motivational Interviewing Treatment Integrity tool (MITI; v4.0; (Moyers et al., 2016)) by an external individual who is not involved with the trial design, running or analysis. We will randomly select the session segment by using an internet random number generator (e.g. random.org) to select a participant ID number at each session timepoint. We

will then use the generator to select a random number between zero and the session duration minus 20, to select the start time point of the segment. The recordings will be transferred securely and in line with the University of Liverpool data management policy. The data will not be identifiable as the audio files will be labelled using ID numbers rather than names. The fidelity assessment will provide an overview of how closely the interventionist utilised MI skills and relational components (the *spirit* of MI). For a budgeting outline of external fidelity assessments, see Appendix p. Random 20-minute segments from all sessions at session 2 and session 3 will be assessed using the MITI by the researcher who delivered the sessions (HM). Inter-rater reliability will be examined using kappa statistics and reported, and summary statistics reported for both assessment routes separately.

2.15.1. Coding session content

To provide understanding of what is involved within the content of the sessions, further coding of audio data will be carried out. Recent developments within MI research have identified clearly defined taxonomies of relational and content-based techniques that are utilised within MI sessions (Hardcastle et al., 2017). All session audio will be coded for MI-specific techniques. A random 25% selection of coding will be second-coded to determine inter-rater reliability.

Coding of Behaviour Change Techniques using the BCCTv1 (Michie et al., 2013) will be conducted of all audio sessions. The coder has received training in using the BCT Taxonomy and completed coding for other research studies. A random 25% of coding will also be conducted by a second researcher who has received training in using the BCT Taxonomy to determine reliability between coders.

Use of the fidelity tool and understanding of specific technique-based components of the session will deliver a greater knowledge of precisely what content is utilised within MI-based interventions within an adult sample living with obesity, and therefore, will be beneficial for improving understanding of how the approach may work as an effective intervention for weight-related behaviour change. Presentation of results will be dependent on outcomes of research question

2. This will provide quantified, evidenced summaries of what techniques are present within the intervention delivered. We will consider 'intervention success' on a participant-by-participant basis as scoring zero or above on the behavioural achievement scale. This scale assesses participants self-reported goal progress using markers of -100 for "*I have not done what I set out to do*", 0 for "*I have achieved exactly what I wanted to*" and +100 for "*I have achieved what I wanted to and more."* Similarly to previous work investigating the use of effective and ineffective techniques within childhood obesity interventions (Martin et al., 2013) we will present effectiveness ratios to identify BCTs that occur most commonly among interventions deemed as successful. BCT effectiveness ratios will be calculated as the number of times each technique is present in interventions reported by participants as resulting in successful behaviour change (self-reported achievement of what was expected and beyond – represented by a score of zero or above), divided by the number of times each technique is present in any intervention (effective and ineffective). Data will be presented in table format with a summary of technique frequency and type during each session group, and global technical and relational scores.

2.16. Adverse events and potential ethical concerns

The study and associated materials have received ethical approval from the Research Ethics Committee at the University of Liverpool (reference number 5724, Appendix q). It is not anticipated that adverse events will be experienced through taking part in this study. Participants will be reminded throughout that the researchers are not medical professionals and cannot provide medical or health advice, and that they should seek medical advice prior to making changes to their dietary intake or embarking on a new exercise routine.

It is not expected that participants will experience emotional distress, but they will be advised to let the research team know should they have any concerns about the study or topics discussed in the intervention sessions. Participants will be provided with additional links for health and wellbeing topics in the debrief sheet at each session. Should participants experience any distress during the individual session, the researcher will end the recording and ask the participant if they would like to take a break. The research team will also follow up with the participant by email or telephone 24

hours later for a wellbeing check. Additionally, in advance of continuing participation in the sessions, the researcher will ask if they are happy to continue taking part, or if they would like to withdraw before arranging subsequent meetings with the participant. The researcher will inform the study PI of any unexpected adverse events immediately after it takes place.

Further it is not expected that involvement with the study will provide any risk of harm to the research team. However, the researcher will only conduct face-to-face sessions on University campus during normal working hours and other individuals will be made aware of the researcher's location. The researcher will always carry a mobile phone and have access to the contact details of the PI, who will be aware of the timing of all sessions via a password-protected shared file. Any distress or discomfort on the part of the researcher will be discussed and addressed as appropriate within regular supervision meetings with the PI taking place after every third session.

2.17. Data storage

Data will be stored in line with the University of Liverpool Data Management Policy and retained for 10 years (Appendix p). The data will only be accessible to the research team. The data will be stored on a password-protected spreadsheet, and held separately to any identifying information (e.g., email addresses and contact telephone numbers). Contact details will only be used for the purpose stated on the information sheet and consent form, and participants will need to provide consent to be contacted about other related research. As the study is designed to run remotely in case of local or national lockdowns due to COVID-19, it is not anticipated that there will be any paper records created. However, any paper records produced will be stored in a locked drawer at the University of Liverpool in the research team's office and held securely in line with the University Data Management Policy for 10 years at the conclusion of the research study.

Chapter 7. What techniques are present within Motivational Interviewing sessions about making weight-related change in an adult population living with obesity? An intervention study with short-term follow-up and nested content analysis.

Foreword

This chapter presents the findings of the planned intervention study to assess Motivational Interviewing (MI) as used to support behaviour change with a sample of adults living with obesity. The aim of this study was to provide further evidence about the mechanisms of MI as assessed using taxonomies of behaviour change techniques, and to assess the effectiveness of this approach at supporting behaviour change. Additionally, this study provided further information regarding the feasibility of a randomised controlled trial and learning opportunities for a larger research study of the effectiveness of MI within this population.

The study reported in this chapter is currently in preparation for submission to a peer-reviewed journal. The contributing authors are: Makin, H.E., Fallon, V.M., Goodwin, L., Humphreys, G., & Chisholm, A.

Abstract

Motivational Interviewing (MI) is a health behaviour change approach. MI uses a distinct set of relational and technical components to build rapport and engagement with the client. Collaboration is approached in an empathic way to support the development of an autonomous plan in the direction of behaviour change. Although research has supported MI use in several health behaviour change settings, the specific mechanism of action in weight-related behaviour change is currently unknown.

Participants (N=32) were randomised to either 3 sessions of MI or 3 control sessions over a 6-week period. Participants recorded their change of interests and weight-related behaviours, including their physical activity, eating behaviour and wellbeing. All sessions were delivered remotely due to the COVID-19 pandemic. Participant perceptions of behaviour change progress were used to assess MI effectiveness. A coding analysis component examined the specific Behaviour Change techniques and MI-specific techniques present in the intervention condition.

Of a possible 93 BCTs, 50 were coded as present in MI sessions. 38 listed MI-specific techniques were coded as present. The most frequently coded BCTs were behavioural goal setting, comparative imagining of future outcomes, and framing and reframing techniques. The most frequently coded MI-specific techniques were open-ended questions, reflective statements, summaries, and affirmations. Descriptive statistics showed increases to physical activity and improved wellbeing from baseline to follow-up for both groups. However, the small sample size prevented intended analyses assessing effectiveness of the intervention in comparison to the control condition.

Findings of effectiveness should be interpreted cautiously due to the single-interventionist delivery and the small sample size. MI may be an effective approach to supporting weight-related behaviour change in obesity, and the methods used for intervention delivery were feasible and could be implemented in a larger trial. The coding analysis nested within the study was an appropriate method to clarifying the content of MI interventions.

1. Introduction

Obesity is a complex and multifactorial condition that involves genetic, environmental, social and behavioural contributors to a range of weight-related behaviours (Perriard-Abdoh, 2019). It is the accumulation of excess bodyweight and the prevalence is increasing globally (Bray et al., 2016, World Health Organisation, 2021). Physiological methods, such as measurement of visceral fat or Body Mass Index (BMI), are commonly used to assess individual risk of obesity. Obesity is believed to be associated with increased risk of hypertension, cardiovascular conditions and Type 2 Diabetes, when compared with populations without obesity (Mokdad et al., 2003; NHS, 2019; Sowers, 2003). Frequently, individuals are advised to reduce their bodyweight to ensure reduction of risks to health (Kushner & Ryan, 2014).

However, the maintenance of successful weight loss can be challenging (Barte et al., 2010). Environmental influences from modern living, including increased sedentary time and food accessibility (Chaput et al., 2011), are complemented by weight-related behaviours such as dietary choices and physical activity, which can be predictive of adolescent and older behaviours (Kitzman-Ulrich et al., 2010; Klesges et al., 1986; Elgar et al., 2005). Research also points towards a heritable aspect of obesity (Bell et al., 2005). Evidence-based, effective, and implementable interventions are required to ensure individuals are supported In the reduction of health risks associated with this condition (National Institute for Health and Social Care Excellence, 2014). Further, individuals living with obesity report experiences of weight-based stigma and bias (Puhl et al., 2020), through day-to-day living and within healthcare seeking settings (Hughes et al., 2021). This may have adverse effects on an individual's psychological and physiological wellbeing through reductions in self-esteem and increased anxiety and depression symptomology (Vartanian & Novak, 2011). There is no single preference regarding terminology appropriate for discussion of adiposity. The current report will use person-first language (Albury et al., 2020; Kyle & Puhl, 2014).

Research has indicated that within global populations of adults (not solely those living with obesity) there may be room for amendments to obesity risk behaviours in line with current best practice recommendations for healthy living (Hallal et al., 2012). Many avenues towards obesity

839 treatment involve behavioural intervention components (National Institute for Health and Social Care
840 Excellence, 2014; NHS, 2019). These are often intended to support an individual with weight loss
841 through changes to eating behaviours; for example, by providing information regarding: nutritional
842 choice, consumption amounts and frequencies, and self-monitoring of intake, and promoting physical
843 activity behaviours such as decreasing sedentary time and increasing walking and exercise regimes
844 (National Institute for Health and Social Care Excellence, 2014; U.S. Preventive Services Task Force,
845 2018). Some research has indicated that commercial weight-loss programs appear to have relatively
846 non-meaningful effects on weight loss and maintenance, and high levels of participant attrition
847 (McEvedy et al., 2017), although programs targeting both diet and physical activity behaviours may
848 have small but significant benefits for the maintenance of weight loss over time (Dombrowski et al.,
849 2014). This suggests that changes to behaviours involved potentially may not be sustainable for
850 participants in the longer-term. Considering the intricacies of an individual's experience of weight-
851 related behaviours, a tailored approach to behavioural intervention is required (Perriard-Abdoh et al.,
852 2019). Therefore, it is necessary to identify aspects of interventions which are effective at producing
853 behaviour change, and which interventions address relevant determinants and can ensure the change is
854 sustainable over a longer period of follow-up (Varkevisser et al., 2019).

855 One such approach towards supporting behaviour change may be identified within therapeutic
856 and counselling communication skills and interventions. Motivational Interviewing (MI; Miller &
857 Rollnick, 2013) is a person-centred, collaborative, empathic approach to resolving feelings of
858 ambivalence about change. It requires expertise of the practitioner to work alongside an individual
859 and respect their autonomy for making changes and support the development of plans towards the
860 change goal that are personalised and specific to the individual client. MI is a complex approach to
861 behaviour change interventions that can include multiple components and techniques (Hagger et al.,
862 2020; Hardcastle et al., 2017).

863 MI skills are used within various domains of behaviour such as alcohol and substance use,
864 paediatric healthcare, dentistry, and adherence to other interventions (Christie & Channon, 2014;
865 Heckman et al., 2010; Kay et al., 2016; Lundahl et al., 2010; Rubak et al., 2005; Possidente, 2005).

There existing evidence base supported the use of MI within a wide range of healthcare settings (Rubak et al., 2005) and it is frequently included within medical education and training courses (Barwick et al., 2012). Within behaviour change intervention research, identifying the active components is an important issue to address (Michie et al., 2013). By clarifying what is involved within specific interventions, researchers can work to locate which aspects are effective in producing behaviour change (Michie et al., 2011). One format of identifying components is the Behaviour Change Taxonomy of Techniques (BCTTv1; Michie et al., 2013). This includes 93 techniques that enable identification of the 'active ingredients' of behaviour interventions, which can be used to support future intervention development and evaluation.

MI has been examined as a potentially effective manner of supporting weight loss and loss maintenance. A recent systematic review (Makin et al., 2021) identified that whilst there was no significant change to bodyweight outcomes in comparison to non-MI comparators, there may be benefits to behavioural outcome measures. Other research has identified that MI is an effective intervention for bodyweight outcomes (Armstrong et al., 2011; Barnes & Ivezaj, 2015). However, there may be issues related to the fidelity and implementation of this complex intervention (Caperton et al., 2018; Hall et al., 2016; Jelsma et al., 2015). A second issue is that MI is predominantly a relational and person-centred approach to change (Miller & Rose, 2010). Due to the person-centredness of the intervention, conversations require a strong rapport between practitioner and patient in order to cultivate an environment that is supportive of change. Researchers have suggested that MI includes both relation-building and content-based techniques (Hagger & Hardcastle, 2014), which may not be fully encompassed within the BCTTv1.

Given the lack of clarity evident in the content of MI as applied within obesity contexts, and mixed findings regarding its effectiveness, a randomised controlled trial is necessary to provide further detail regarding its effectiveness and components. The components of MI interventions can be defined using coding approaches to confirm what BCTs and MI-specific relational and content-based techniques are present in this complex intervention. This approach will permit identification of the smallest components of the intervention as delivered in the ethos of MI. Further, research which

allows investigation of the effectiveness of this intervention will add to the evidence base regarding the application of person-centred, empathic, collaborative approaches to change in this context. Whilst it is important to establish this through appropriately designed research trials, the feasibility of this approach needs to be assessed first.

The aims of the current study were as follows; a) to identify the feasibility of running a two-arm Motivational Interviewing trial using an active intervention group and a comparator, and to identify the retention rates of participants; b) to identify the effectiveness of the intervention at producing behaviour change over a 3-month period, and allow for use of data in future power calculations for complete trials, and c) to clearly define the techniques present within this complex intervention. To achieve these aims, the research used a randomised controlled design comparing a 6 - week Motivational Interviewing intervention to an information-only condition. Participants were allocated on an individual basis and measures related to their behavioural determinants, physical activity, eating behaviours and wellbeing were taken at baseline, post-session 2, post-session 3, and 12-weeks post baseline. The specific research questions were,

- How feasible were the recruitment processes, intervention delivery and retention of participants to a Motivational Interviewing research trial for weight-related behaviour change in the context of obesity? Were there any changes to be made in preparation for future trials?
- [Exploratory] Was Motivational Interviewing likely to be an effective individual intervention for weight-related behaviour change in an adult sample with obesity in comparison to the provision of information?
- [Exploratory] What were the relational and technical factors present in successful individual-level Motivational Interviewing interventions for weight-related behaviour change in a sample of adults with obesity?

2. Methods

2.1. Participants

Participants were recruited between September-December 2020. Initial start dates were November 2020, with participants joining the study on a rolling basis based on session availability and participant preference. The final participants started the study in January 2021. The study took place during UK COVID-19 restrictions including national and regional lockdowns including stay-at-home and work from home guidance (see (Institute for Government, 2022) for restriction timelines). Recruitment advertisements were shared online through publicly viewable social media sites (Twitter; Facebook; Instagram (Appendices s and t) and private groups related to weight management and obesity support. Interested individuals contacted the researcher (HM) via email or telephone for more information and a copy of the information sheet (Appendix r). Eligibility criteria were confirmed via email and participants were asked to confirm that they met the necessary criteria to take part. Eligibility and exclusion criteria are outlined in Table 11.

Table 11. Inclusion and exclusion criteria for participants

Inclusion criteria	**Exclusion criteria**
Have a current BMI of 30.00 kg/m^2 and above (calculated using a widely available NHS formula calculator (https://www.nhs.uk/live-well/healthy-weight/bmi-calculator/))	Current BMI of 29.99 kg/m^2 and below
Have a current interest in changing a weight-related behaviour, for example eating behaviours such as snacking, or physical activity behaviour such as sports, gardening or walking, or other behaviour related to weight like seeking guidance, social support or further information	No interest in changing weight-related behaviours
Not have any medical conditions which may impact on your ability to make changes to the desired behaviour	Health conditions that will limit ability to change the desired behaviour

Inclusion criteria	Exclusion criteria
Be willing to take part in up to 3 x 60-minute, individual sessions with a researcher discussing their desired behaviour change	Unable to take part in the research sessions if allocated to the intervention condition or control group

930

931 ## 2.2. Materials

932 Questionnaires were hosted on the Qualtrics website (livpsych.eu.qualtrics.com; Appendix u).
933 Participants were asked to self-report demographic characteristics (age; sex; BMI; behaviour change
934 of interest; experience of past discussion with healthcare staff about obesity; any relevant pre-existing
935 health conditions which may impact behaviour change goals) at baseline. Participants were also asked
936 to complete the Appetite Drive Subscale of the Addiction-like Eating Behaviour Scale (AEBS), a
937 validated and reliable measure of appetite behaviour (Ruddock et al., 2017). This questionnaire
938 features nine items, such as 'I continue to eat despite feeling full,' and responses are provided on a 5-
939 point scale ranging from Never (=1) to Always (=5). Baseline data from the current sample were used
940 to calculate Cronbach's alpha, indicating a high level of internal consistency (Cronbach's alpha =
941 0.87).

942 Physical activity data was collected using the International Physical Activity Questionnaire
943 Short Form (IPAQ-SF, (Craig et al., 2003; Lee et al., 2011)). This questionnaire collected information
944 about participants engagement and duration with vigorous, moderate, walking, and sitting (sedentary)
945 behaviour over the preceding 7 days, providing metabolic equivalent minutes of activity and
946 categorisation of high, low, or moderate activity levels. Sedentary activity is not included when
947 calculating the activity level. The IPAQ is a widely used tool, although concerns have been raised
948 about its reliability due to self-reporting of activity data (Lee et al., 2011). Data reported by the
949 current sample at the baseline measurement were used to calculate internal consistency, which was
950 unacceptable (Cronbach's alpha = 0.29). The sedentary activity score was not included as this does
951 not contribute to calculation of the overall activity level. Internal consistency findings have been
952 reported in cross-cultural studies to be moderate (Cronbach's alpha = 0.6;(Mannocci et al., 2014, Ács

et al., 2021) and poor in disease-specific validation studies (Cronbach's alpha = 0.4;(Meeus et al., 2011).

To assess well-being, the WHO-5 Wellbeing Index Scale (WHO-5, (World Health Organisation Regional Office for Europe, 1998)) was used. 5 statements such as, 'I have felt calm and relaxed,' are scored on a 5-point scale from 'At no time' (=0) to 'Always' (=5) with regards to the previous 2 weeks. Higher scores indicate better well-being. Internal consistency of the sample's scores at baseline was good (Cronbach's alpha = 0.85).

Information about participants' perceptions of behavioural determinants of their intended change including the capability, opportunity and motivation to engage with it was collected using a brief validated and reliable measure (Keyworth et al., 2020). 6 items such as, 'I have the physical opportunity to change my behaviour,' were scored by participants on a scale ranging from 'Strongly Disagree' (=0) to 'Strongly Agree' (=10). The internal consistency of this measure was good in the current sample (Cronbach's alpha = 0.80). To identify participants perceptions of their progress towards behaviour change, we included a visual analogue slider scale (VAS) from -100 to +100, with the end of the scale representing, 'I have done a lot less than what I wanted to do,' and 'I have done a lot more than what I wanted to do'. A score of 0, positioned in the centre of the line, was annotated with the text, 'I have achieved exactly what I wanted to'. Participants were also asked to provide a brief text answer detailing the reason they had selected this slider response in a text box below the line.

Outcome surveys were completed at each timepoint (baseline, post-session 2, post-session 3, and at 12-week follow-up). In addition to the surveys at the final follow-up, participants were asked to provide their current bodyweight and BMI. All email contact with participants included a link to a webpage hosted on the Qualtrics site with a reminder of information about participants' right to withdraw. The page provided the option to withdraw from the study via completing a form, and a statement that participants could withdraw from the study sessions but continue to provide outcome assessments if preferred.

2.3. Procedure

After eligibility criteria were confirmed, participants were sent a link to complete the informed consent form and the first study measures. Participants were advised that no medical advice would be provided and to speak with their GP in advance of any changes that may have health implications. They were advised of the study procedures and to complete the link when they had at least 60-minutes available. Following completion of baseline measurements, participants were randomly allocated by Qualtrics software to the intervention or comparator condition.

Participants allocated to the information condition (comparator group) were asked to immediately watch informational videos, which provided generic advice from nationally recognised resources such as the NHS related to eating and physical activity, non-specific to obesity intervention. Participants allocated to the intervention provided their contact information, which was automatically emailed to the study investigator to arrange the first meeting. This was arranged based on participant availability to take place as soon as possible following the baseline questionnaire completion.

Intervention sessions were delivered by one Psychology PhD researcher (HM) who had attended beginner and intermediate level workshops about MI, completed online modules with the BMJ, and engaged with regular supervision sessions with a Motivational Interviewing Network of Trainers (MINT) registered trainer and a HCPC registered Health Psychologist. Session content was tailored in line with the participant interests, such as discussion regarding specific eating behaviours or physical activity interests. Subsequent sessions were arranged at 2-week intervals, with each intervention participant attending up to 3 sessions. The survey links were issued by email immediately following sessions 2 and 3, and 6 weeks after this for the final follow-up.

The comparator group were invited to watch the videos and complete surveys at 2-week intervals up to a maximum of 3 times. The videos were 35 minutes in duration which was matched to the mean length of face-to-face MI sessions during an earlier study focused on physical activity behaviour change. Invites to watch the video and complete surveys were sent through the Qualtrics

software to remove the need for manual administration of reminders and to ensure intervals were accurately timed.

For participants in the intervention group, contact was attempted to rearrange missed sessions twice before considering the participant withdrawn. Participants were sent links to complete the outcome measures at the expected timepoints (post-session 2, post-session 3, and 12-weeks post-baseline) unless they requested withdrawal from outcome assessment. For participants in the control group, if no response was received to two follow-up emails, they were considered withdrawn. Participants only received an email inviting them to complete the next session or follow-up if they viewed the final set of survey questions in the previous session, i.e., participants who closed their browser during the initial baseline measures in session 1 were not emailed to complete session 2, session 3, and the 12-week follow-up.

At the bottom of reminder emails, participants were able to follow a link to a short survey where they could inform the research team they would like to withdraw and provide a reason. They could opt to continue to complete surveys without attending sessions. No participants completed the form. After completing the study surveys, participants were shown the debrief form (Appendix v).

2.4. Design

The study used a two-arm, individually randomised controlled trial which took place over a 12-week period. This encompassed a 6-week intervention period and a follow-up at approximately 12-weeks post-randomisation. Participants were randomised 1:1 by a computerised random allocation process (www.livpsych.eu.qualtrics.com). Data was collected at 4 timepoints (baseline; post-session 2; post-session 3; 12-week follow-up). The study and associated materials received ethical approval from the Research Ethics Committee at The University of Liverpool (reference number 5724, Appendix q).

2.5. Data analysis

Outcomes map onto the core outcome set for reporting of obesity interventions (Mackenzie et al., 2020). As MI intends to address behaviour, and it is unlikely to see significant changes in measures of

bodyweight or BMI within a short timeframe as indicated in the current study, no changes to these outcomes were expected. Bodyweight data was collected through self-report measures at baseline and 12-week final follow-up. Process and optional outcomes were also collected (specifically, retention of participants and reasons for withdrawal, data related to physical activity and eating behaviour, wellbeing, behavioural determinants and behaviour change achievement).

The proportion of participants who were eligible and ineligible to take part are reported in the results section. Retention rates of participants and completion rates of study surveys (% of participants retained and completing surveys) are also reported to determine if the trial and measures utilised are feasible and appropriate for use within a trial addressing the use of MI as an intervention for weight-related behaviour change in obesity care. Data on the number of ineligible participants excluded at screening stages and drop out have been reported through participant flow diagrams to assess the timings and completion of participants involved in the control group, who received automatic email prompts to complete sessions and surveys. Participants who no longer wished to take part in the study were invited to provide written reasons for drop-out.

Analyses investigated the effect of the intervention on self-reported behavioural achievement at the 12-week follow-up as a primary outcome of effectiveness, the results of which can be used for future power calculations. This was measured using an unvalidated, single-item measure of behavioural achievement, which states, “In relation to the change I wanted to make…” and invites participants to select a number on a sliding scale from -100 to +100. At either end of the scale, a prompt states, “I have done a lot less than what I wanted to do” and “I have done a lot more than what I wanted to do.” On the scale, 0 is prompted as representing “I have done exactly what I wanted to do.” Participants are also invited to complete a free-text response box that states “please could you tell us a bit more about whey you provided this answer?”

The contents of the intervention were examined using predefined measurement tools for treatment fidelity (MI Treatment Integrity scale; MITI 4.0; (Moyers et al., 2016)), the recently defined MI-specific techniques (Hardcastle et al., 2017) and the Behaviour Change Techniques Taxonomy (BCTTv1; (Michie et al., 2013)). This was carried out by one researcher (HM). 25% of sessions were

also second-coded by a PhD researcher (GH) outside of the research team (HM and AC) who had received training to use the BCTTv1. Inter-rater reliability scores were calculated as Cohen's kappa and prevalence-adjusted bias-adjusted kappa scores (Byrt et al., 1993; Cohen, 1968). All sessions were coded for techniques. Intervention 'success' was considered on a participant-by-participant basis as scoring zero or above on the behavioural achievement scale at final assessment. Participants were asked to report their perceptions of goal progress using a visual analogue scale (VAS) using anchors of -100, 0, and +100. A score of 0 or above at final measurement was classed as a 'successful' intervention as this anchor represented "I have achieved exactly what I set out to do."

Between group effect sizes (Cohen's d for parametric data and an estimate of r based on the z-score for non-parametric data) for eating behaviour scores, wellbeing scores, physical activity metabolic equivalent minutes, and behavioural determinant scores were calculated by subtracting the mean of the intervention group from the mean of the comparator group and dividing the result by the standard deviation (SD) of the total sample (all participants). Physical activity data, reported in metabolically equivalent (MET minutes) to provide an overview of activity from different categories (e.g., moderate, vigorous) was skewed and therefore Cohen's d was not calculated. The within-group effect size was calculated using the mean and standard deviation of baseline and last-available measurement (last observation carried forward; LOCF approach) to calculate Cohen's d and 95% confidence intervals. Effect sizes were computed for parametric data using an open-access Excel template developed by Lakens (Lakens, 2013).

3. Results

To assess intervention effects over time, data was collected at baseline, post-session 2, post-session 3, and approximately 12 weeks following baseline. This resulted in data from 4 timepoints. Across the intervention and comparator groups the average age was 46 years (SD=12.85). Most participants were female (96.9%). The median BMI of participants was 39.60 kg/m^2 (ranging from 30.30 to 67.10 kg/m^2). See Table 12 for reporting of participant characteristics at baseline. 56.2% of participants reported an existing health condition which they felt may impact on their intended behaviour change. Of these participants, 40.6% reported physical health conditions, 6.3% reported

mental health conditions and 9.4% reported both. The percentage of participants reporting previous discussion about obesity with a healthcare professional was 59.4%, indicating a majority had discussed obesity in a healthcare setting previously. Five participants were recruited from patient advocacy group social media advertisements, eight patients were recruited from university networks, four patients were recruited from wider social media advertisements and the recruitment location was unknown for the remaining patients.

Table 12. Descriptive statistics of participant characteristics at baseline.

Characteristic	**Total group (N=32)**	**Intervention group (N=16)**	**Comparator group (N=16)**
Age	46.16 (12.85) years	42.80 (10.50) years	40.68 (7.56) years
Sex	96.9% female (3.1% male)	93.8% female (6.3% male).	100% female (0% male)
BMI	Median 39.60 (range 30.30 to 67.10)	Median 39.65 (range 30.30 to 58.20)	Median 39.09 (range 30.80 to 67.10)
Data are mean and standard deviation unless otherwise stated, where median and range are reported due to non-parametrically distributed data.			

3.1. Numbers recruited to the study

37 individuals were screened for entry to the study. 32 were eligible to take part and began the first survey assessments and randomisation process. Participant numbers are reported in Figure 13. Three potential participants were assessed as ineligible to participate and did not complete randomisation or baseline assessments. Two participants declined to participate after confirming eligibility due to external personal factors such as scheduling conflicts.

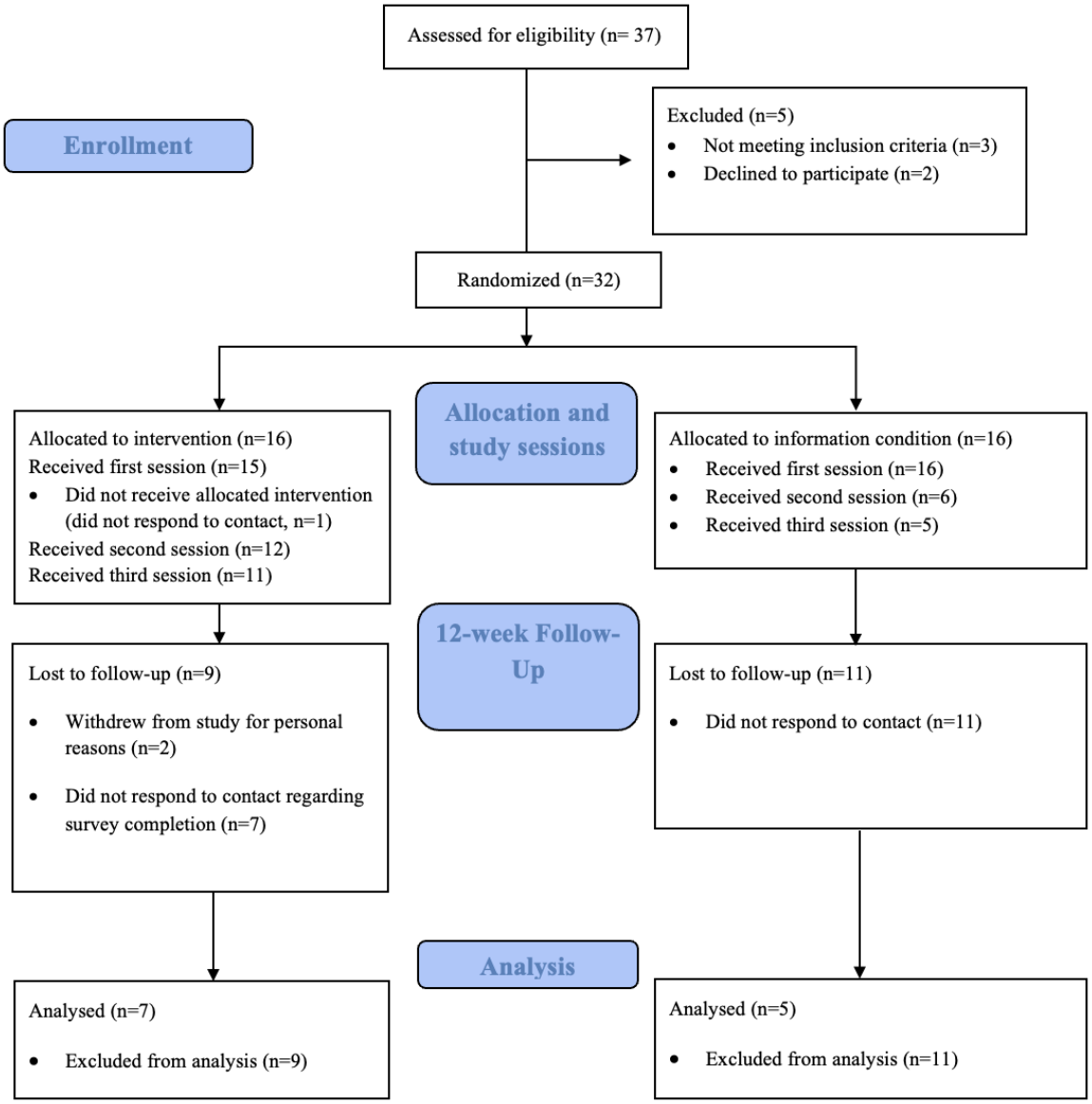


Figure 13. Participant flow diagram.

3.2. Survey completion rates

Across both arms, the percentage of participants retained to the second session surveys was 46.88% (n=15). In the third session, the number of participants completing surveys was 50% (n=16) as one participant did not complete session 2 surveys but did complete session 3 surveys. In the 12-week follow-up survey, the completion percentage was 37.5% (n=12).

In the comparator group, 11 participants did not respond to contact. The greatest number of participants dropping out in the comparator group was between sessions 1 and 2 (n=10). In the

intervention group, 2 participants withdrew for personal reasons unrelated to the study during the national lockdown period, including COVID illness. Seven participants did not respond to contact to arrange sessions/complete surveys. No adverse events were reported by any participants.

Table 13. Descriptive statistics of survey outcomes (data are mean±SD unless otherwise stated).

Outcome and timepoint	**Total group**	**Intervention group**	**Comparator group**	**Effect size (Cohen's d for parametric data and r for non-parametric data) within group from baseline to follow-up**	**Effect size (Cohen's d (Lakens, 2013) for parametric data and r for non-parametric data) between intervention and comparator groups**
Baseline	**N=32**	**N=16**	**N=16**		
WHO-5	8.97 (4.84)	8.25 (5.34)	9.69 (4.35)	Intervention: Cohen's d = 0.68, 95%CI 0.57 to 4.70 Comparator: Cohen's d = 0.48, 95%CI -0.18 to 3.68	Cohen's d = 0.29 (95%CI -2.08 to 4.96)
AEBS (ADS)	31.41 (6.64)	33.19 (5.84)	29.63 (7.08)	Intervention: Cohen's d = 0.83, 95%CI 1.59 to 7.29 Comparator: Cohen's d = 0.34, 95%CI -0.96 to 4.32	Cohen's d = 0.57 (95%CI -8.25 to 1.13)
IPAQ-SF MET minutes	Median 993 (Range 6426) 40.6% Low activity levels 46.9% Moderate activity levels 12.5% High activity levels	Median 993 (Range 0 to 6426) 50% Low activity levels 37.5% Moderate activity levels 12.5% High activity levels	Median 1122.75 (Range 0 to 3699) 31.3% Low activity levels 56.3% Moderate activity levels 12.5% High activity levels	Intervention: r = -0.64 Comparator: r = 0.54	r = -0.06

Outcome and timepoint	**Total group**	**Intervention group**	**Comparator group**	**Effect size (Cohen's d for parametric data and r for non-parametric data) within group from baseline to follow-up**	**Effect size (Cohen's d (Lakens, 2013) for parametric data and r for non-parametric data) between intervention and comparator groups**
COM	38.34 (10.22)	37.25 (9.70)	39.44 (10.92)	Intervention: Cohen's d = 0.062, 95%CI -3.35 to 4.23 Comparator: Cohen's d = 0.14, 95%CI -2.99 to 5.16	Cohen's d = 0.21 (95%CI -5.28 to 9.65)
Post-session 2	**N=15**	**N=9**	**N=6**		
WHO-5	11 (5.58)	11 (6.30)	11 (4.86)		Cohen's d = 0 (95%CI -6.45 to 6.45)
AEBS (ADS)	28.60 (7.24)	30 (7.01)	26.50 (7.69)		Cohen's d = 0.48 (95%CI -11.54 to 4.54)
IPAQ-SF MET minutes	Mdn 1188 (Range 6412) 40% Low activity levels 26.7% Moderate activity levels 33.3% High activity levels	Mdn 1188 (Range 6412) 44.4% Low activity levels 44.4% Moderate activity levels 11.1% High activity levels	Mdn 1596 (Range 4030) 50% Low activity levels 16.7% Moderate activity levels 33.3% High activity levels		r = -0.27
COM	40.87 (10.26)	38.67 (10.94)	44.17 (9.02)		Cohen's d = 0.53 (95%CI -5.90 to 16.90)
Post-session 3	**N=16**	**N=10**	**N=6**		

Outcome and timepoint	Total group	Intervention group	Comparator group	Effect size (Cohen's d for parametric data and r for non-parametric data) within group from baseline to follow-up	Effect size (Cohen's d (Lakens, 2013) for parametric data and r for non-parametric data) between intervention and comparator groups
WHO-5	11.80 (5.17)	12.80 (5.35)	9.80 (4.66)		Cohen's d = 0.59 (95%CI -8.66 to 2.66)
AEBS (ADS)	26.69 (8.41)	25.40 (6.15)	28.83 (11.63)		Cohen's d = 0.40 (95%CI -6.01 to 12.87)
IPAQ-SF MET minutes	Mdn 1506 (Range 8880) 25% Low activity levels 50% Moderate activity levels 25% High activity levels	Mdn 1287 (Range 3492) 20% Low activity levels 60% Moderate activity levels 20% High activity levels	Mdn 1693 (Range 7771.50) 33.3% Low activity levels 33.3% Moderate activity levels 33.3% High activity levels		r = -0.24
COM	36.63 (13.05)	38 (12.72)	34.33 (14.49)		Cohen's d = 0.27 (95%CI -18.49 to 11.15)
12-week follow-up	N=12	N=7	N=5		
WHO-5	13 (4.81)	12.43 (4.28)	13.80 (5.90)		Cohen's d = 0.27 (95%CI -5.14 to 7.88)
AEBS (ADS)	23.72 (5.68)	25.43 (5.20)	20.75 (5.91)		Cohen's d = 0.51 (95%CI -10.50 to 4.56)
IPAQ-SF MET minutes	Mdn 2832 (Range 7359)	Mdn 2619 (Range 7359)	Mdn 2832 (Range 5764)		r = -0.11

Outcome and timepoint	Total group	Intervention group	Comparator group	Effect size (Cohen's d for parametric data and r for non-parametric data) within group from baseline to follow-up	Effect size (Cohen's d (Lakens, 2013) for parametric data and r for non-parametric data) between intervention and comparator groups
		50% Low activity levels 50% High activity levels	60% High activity levels 40% Moderate activity levels		
COM	36.25 (12.07)	34 (12.86)	39.40 (11.46)		Cohen's d = 0.43 (95%CI -10.67 to 21.47)
BMI	Mdn 37.44 (Range 28.70)	Mdn 37.20 (Range 28.70)	Mdn 37.69 (Range 15.80)		
WHO-5 Wellbeing Index: Max score 25, greater scores indicate more positive wellbeing. Appetite drive subscale of the Addiction-like Eating Behaviours Scale: Max score 45, greater scores indicate greater addiction-like eating behaviours. IPAQ Short Form: 7-day recall of physical activity behaviours including vigorous, moderate, walking behaviour and average daily sitting time. MET minutes are metabolic equivalent representations of energy used during physical activity and exercise. Data reported are mean + standard deviation, unless otherwise stated due to non-parametric distribution of the data.					

2

3.3. MITI fidelity checks

Two Health Psychology practitioners external to the study team with current experience of implementing Motivational Interviewing skills in their professional practice, delivering training to professionals, and attendance at intermediates/advanced level training, assessed a random selection of 4 audio tapes each (N=8). Across both coders, audio met beginner proficiency for technical global scores (>3.5) and reflection to question ratio (>1:1) and good proficiency for relational scores (>4.5). The percentage of complex reflections did not meet recommended proficiency (11% of reflections were complex and 89% were coded as simplistic reflections). The authors of the MITI 4.0 advise that engaging and focusing within MI can be characterised by the partnership and empathy global scores. In the current study, both domains scored highly in a sample of audio assessed by external practitioners (M = 4, SD = 0.82 and M = 4.71, SD = 0.49 respectively).

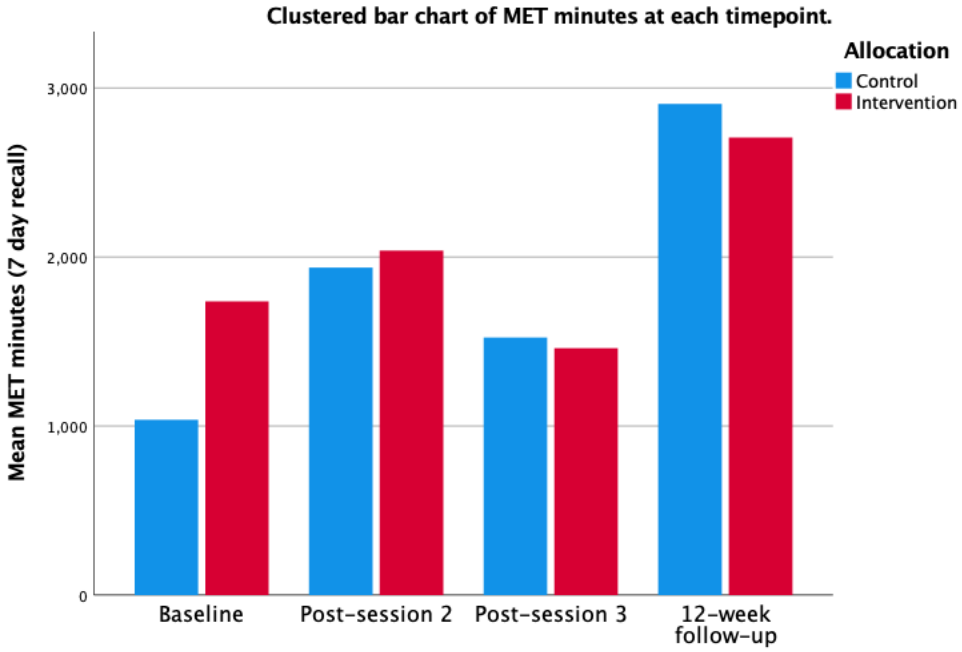
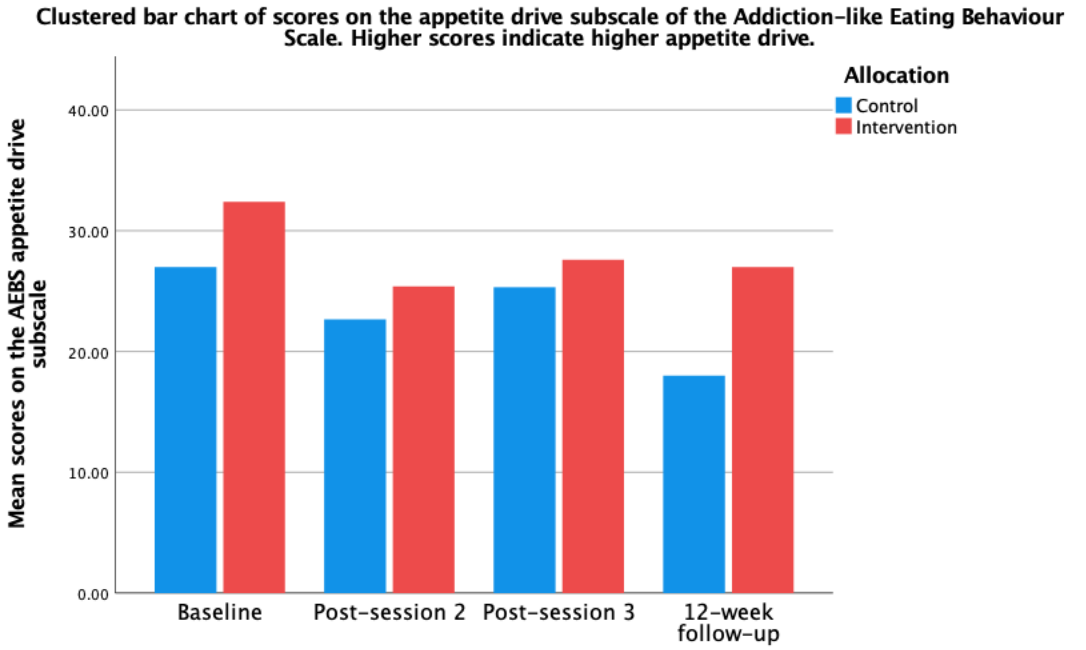
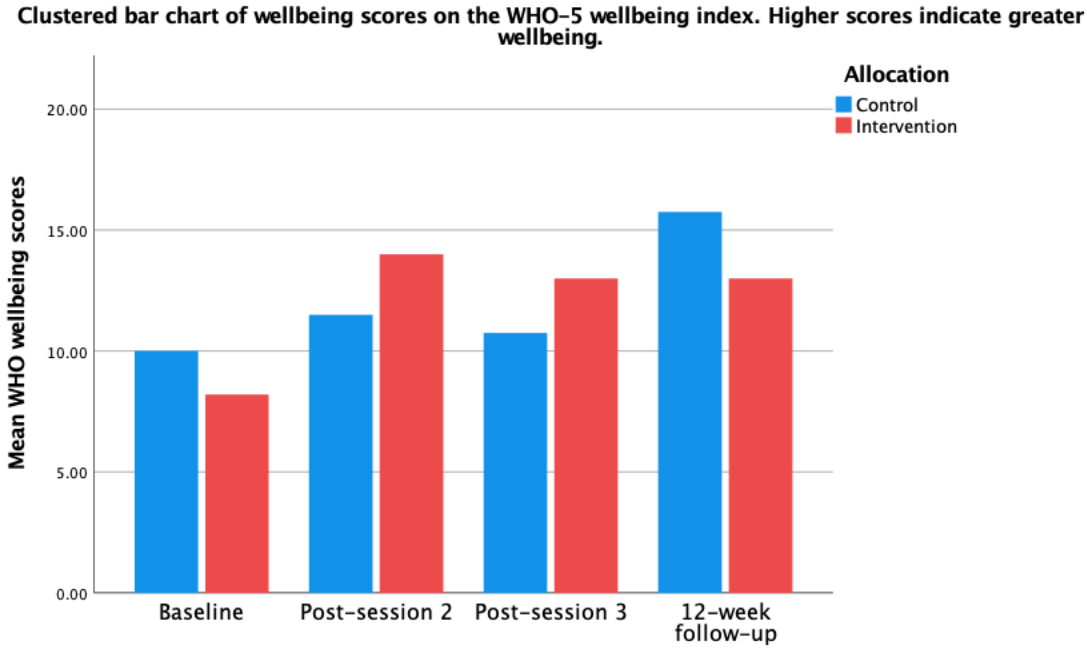


Figure 14. Bar chart representing changes to physical activity (MET minutes) across sessions.



15

16 *Figure 15. Bar chart representing changes to eating behaviour scores across sessions.*



17

18 *Figure 16. Bar chart representing changes to wellbeing scores on the WHO-5 wellbeing index.*

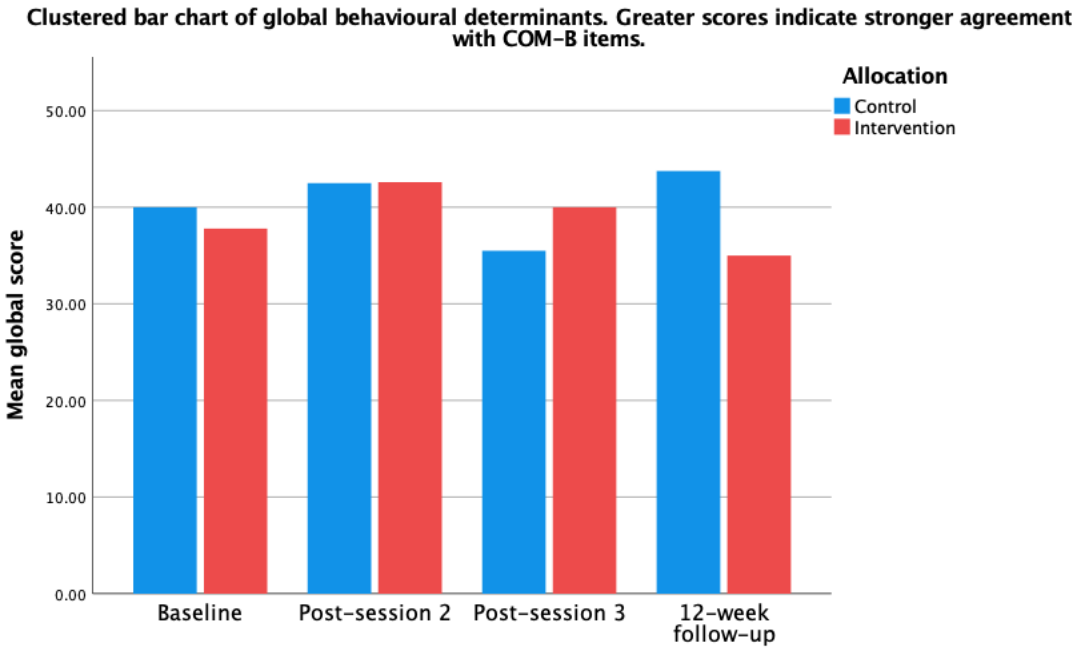


Figure 17. Bar chart representing changes to global COM-B determinant scores across sessions.

3.4. Inter-rater reliability

Three coders completed the coding component of the study. Cohen's kappa and prevalence-adjusted bias-adjusted kappa statistics were computed between the coding pairs. We utilised prevalence-adjusted and bias-adjusted kappa statistics (PABAK) with the formula $2P_o - 1$ and used a cut-off of .61 to indicate substantial agreement between raters. All inter-rater reliability assessments met or exceeded this cut-off. Between coders AC/HM, inter-rater agreement was fair when utilising Cohen's kappa (k>.23). When assessing using PABAK, inter-rater agreement was good to excellent (PABAK > .77). Between GH and HM coders all audio was rated as substantial to excellent agreement using prevalence and bias adjusted statistics (PABAK >.61) and fair to moderate using Cohen's Kappa (k >.25).

3.5. Feasibility outcomes

3.5.1. Content analysis of free-text responses related to VAS scores

We also collected data regarding participants' involvement with healthcare professionals and external support in relation to weight management and use of technology to support their behaviour

change at baseline and final measurement timepoints. Of those who indicated they had discussed obesity with a healthcare professional previously, n=10 referred to specialist weight management services such as local Tier 3 services, n=12 stated they had had discussions with their GP in the past, and n=3 referenced involvements with community group-based behavioural weight loss programmes. 3 participants reported using technology to support their behaviour change, including wearable measurement watches such as Fitbit (n=1), Garmin (n=1) and step counter apps (NHS Active 10, n=1). One participant stated in this section that they had used medication previously but did not provide further detail.

At baseline, 22 participants reported an interest in both physical activity and eating behaviour goals. 6 participants were interested in making changes to only eating behaviour and 1 participant was interested in solely physical activity behaviour. At the first post-session timepoint, no participants specified an interest in both physical activity and eating behaviour changes. 10 participants wished to focus on eating behaviours and n=5 on physical activity behaviours. At the second post-session timepoint, 1 participant provided a general goal ("weight loss"), 11 participants were interested in eating behaviours and n=3 wanted to focus on physical activity. At the final timepoint, most participants who completed the survey were interested in making changes to eating behaviours (n=9) and 3 participants wished to focus on physical activity. No participants reported an interest in both topics at the second or third timepoints, indicating a more specific focus on goal domains after the first session was complete.

Participants were asked at each timepoint to identify their behaviour change goal and provide a short amount of detail in a free-text response box. To assess the use of self-report progress proximity, participants then completed a sliding scale of -100 ("I have done a lot less than I wanted to do") to +100 ("I have done a lot more than what I wanted to do"), with a score of 0 representing, "I have done exactly what I wanted to do," in relation to the behaviour change goal outlined. A brief content analysis of participant responses in free-text boxes asking for additional information regarding their self-reported goal progress was completed. The responses were coded using NVivo 12 by one researcher (HM) and categorised into descriptive groups which are summarised in Table 14.

Frequency counts are not provided, as differences in the level of detail provided by participants means the content quantity is not comparable between participants.

Table 14. Content analysis of participant free-text box responses split by self-reported progress to goal and study timepoint.

Timepoint	**Scores under zero [a]** **Scores between, -100 (*"I have done a lot less than what I wanted to do")* and 0 (*"I have done exactly what I wanted to do."*)**	**Scores over zero [a]** **Scores between, 0 (*"I have done exactly what I wanted to do."*) and +100 (*"I have done a lot more than what I wanted to do").***
Baseline	Psychological contributors such as self-control, stress, emotional regulation Struggling with progress/ maintenance Struggling with motivation Lockdown impacts Health reasons motivating change Managing hunger sensations	Psychological contributors Struggling with progress/maintenance Lockdown impacts Health reasons motivating change
T1	I am not progressing as preferred I am happy with my progress Bad weather/companions absent	I am happy with my progress It is a learning journey
T2	Lockdown has impacted my progress I am happy with what I have achieved I don't find pleasure in my walking Psychological factors/stressors I should do more I forget my commitment	I am happy with my progress, it is a learning journey
T3	It's hard to keep on track Lockdown impacts Not enough progress has been made Bad weather has impacted my progress	I am regularly engaging with change activities.
[a] Participants completed a sliding scale of -100 ("I have done a lot less than I wanted to do") to +100 ("I have done a lot more than what I wanted to do"), with a score of 0 representing, "I have done exactly what I wanted to do," in relation to the behaviour change goal outlined. A score of zero would have		

Timepoint	Scores under zero [a] **Scores between, -100 (“*I have done a lot less than what I wanted to do”)* and 0 (“*I have done exactly what I wanted to do.”*)**	Scores over zero [a] **Scores between, 0 (“*I have done exactly what I wanted to do.”*) and +100 (*“I have done a lot more than what I wanted to do”).***
described that the participant felt they were achieving exactly what they wanted to do, and therefore would have been indicative of an effective intervention in the subsequent content-based analysis.		

65

66 3.6. Technique coding analysis

67 Audio was coded for BCT and MI-specific techniques (Hardcastle et al., 2017; Michie et al.,
68 2013). Of a possible 93 BCTs, 50 were coded as present. All 38 MI techniques were coded as present.
69 There was a difference between the mean number of BCTs coded in the audio of sessions with
70 successful (M=15.14) versus non-successful outcomes (M=8.63) and the number of MI.Ts (M=27 in
71 successful interventions versus M=18.5 in non-successful interventions).

72 Across all audio data, the most frequently coded BCTs were action planning (1.4), goal
73 setting (behaviour; 1.1), comparative imagining of future outcomes (9.3), framing and reframing
74 (13.2) and review behavioural goals (1.5). A session breakdown of technique frequency is reported in
75 Table 15.

Table 15. Most frequently coded behaviour change techniques (BCTs) across each session.

	Session 1	**Session 2**	**Session 3**
Techniques coded most frequently as present	Action planning (1.4)	Monitoring of emotional consequences (5.4)	Action planning (1.4)
	Goal setting (behaviour; 1.1)	Action planning (1.4)	Goal setting (behaviour; 1.1)
	Comparative imagining of future outcomes (9.3)	Review behavioural goals (1.5)	Problem solving (1.2)
	Problem solving (1.2)	Prompts/cues (7.1)	Review behaviour goals (1.5)
	Social support (practical; 3.2)	Framing/reframing (13.2)	Self-monitoring of outcome of behaviour (2.4)

MI-techniques were also examined across sessions. Across all audio data, the most frequently coded were open-ended questions (1), reflective statements (3), summary statements (4), affirmations (2) and agenda mapping (5). See Table 16 for the most frequently coded techniques reported according to session number.

Table 16. Most frequently coded MI techniques across each session.

	Session 1	**Session 2**	**Session 3**
Most frequent techniques	Open-ended questions (1)	Open-ended questions (1)	Open-ended questions (1)
	Affirmations (2)	Reflective statements (3)	Reflective statements (3)
	Reflective statements (3)	Summary statements (4)	Summary statements (4)
	Summary statements (4)	Affirmations (2)	Coming alongside (27)
	Emphasise autonomy (24)	Agenda mapping (5)	Normalizing (30)
N relational techniques coded as present (%)	97 (47.78%)	72 (51.80%)	69 (48.59%)

	Session 1	Session 2	Session 3
Most frequent techniques	Open-ended questions (1)	Open-ended questions (1)	Open-ended questions (1)
	Affirmations (2)	Reflective statements (3)	Reflective statements (3)
	Reflective statements (3)	Summary statements (4)	Summary statements (4)
	Summary statements (4)	Affirmations (2)	Coming alongside (27)
	Emphasise autonomy (24)	Agenda mapping (5)	Normalizing (30)
N content-based techniques coded as present (%)	106 (52.22%)	67 (48.20%)	73 (51.41%)
Total N techniques coded	203	139	142

To allow for closer examination of the effectiveness of BCTs (Martin et al., 2013), change scores within the intervention group that were above zero were used as an indicator of self-reported progress. Only the intervention group codes were included within effectiveness ratio calculations, as the comparator condition received no individually tailored support. To calculate effectiveness ratios, the number of times the technique was present in interventions that had a change score above zero (indicating improvement compared to baseline) was divided by the number of times it was present across all participants regardless of change score outcome.

With regards to the BCTs, there were 8 techniques with effectiveness ratios of 100%, suggesting that all sessions they were present in resulted in participants reporting behaviour change beyond what they had planned to achieve (Figure 18). These techniques were goal setting – outcomes (1.3), feedback on behaviour (2.2), information about antecedents (4.2), salience of consequences (5.2), information about others' approval (6.3), behaviour substitution (8.2), habit formation (8.3) and pros and cons (9.2). However, some of these techniques (1.3, 2.2, 4.2, 5.2, 6.3, 8.2, and 8.3) were only present in two sessions and therefore should be interpreted cautiously. 8 techniques had effectiveness ratios below 50%; goal setting – behaviour (1.1), framing/reframing (13.2), self-monitoring of

behaviour (2.3), behavioural experiments (4.4), social comparison (6.2), habit reversal (8.4), valued self-identify (13.4) and comparative imagining of future outcomes (9.3).

3 MI techniques had effectiveness ratios of 100% but were only present in two participants; permission to provide information and advice (7), undershooting (26) and review outcome goal (37) (Figure 19). 8 techniques had effectiveness ratios of between 33.33% and 46.67%; goal attainment scaling (34), consider change options (32), identify past successes (17), brainstorming (19), open-ended questions (1), affirmations (2), reflective (3) and summary statements (4).

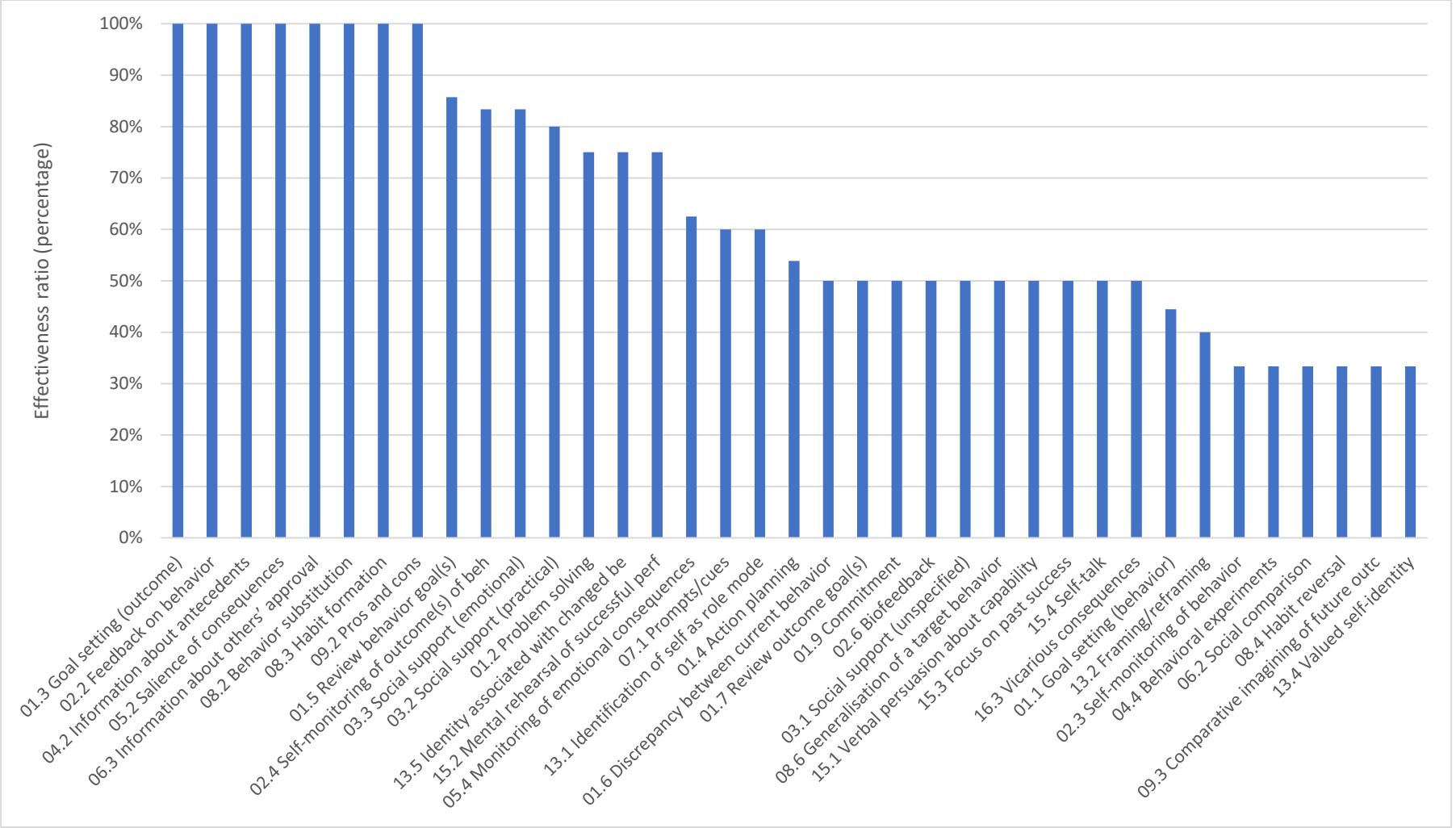


Figure 18. Effectiveness ratios of BCTs

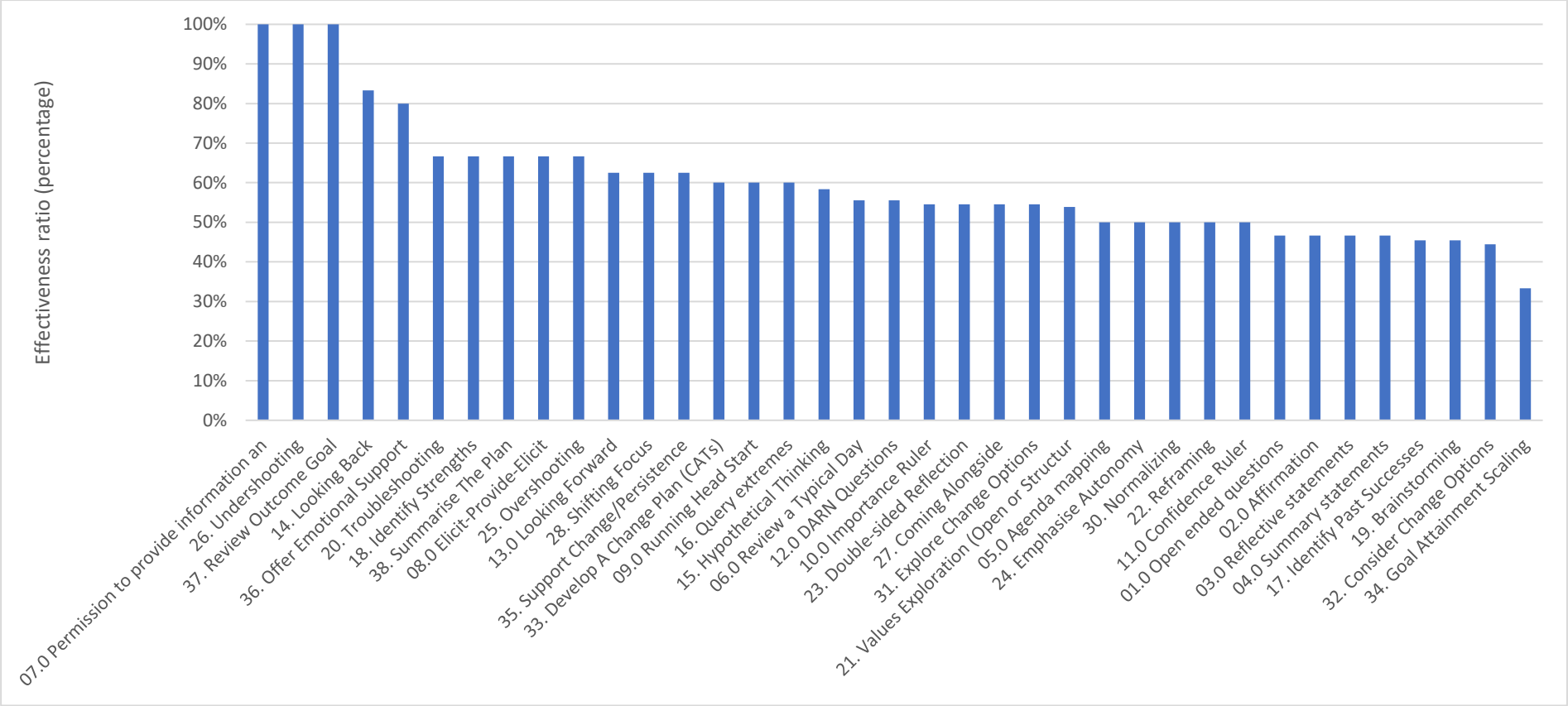


Figure 19. Effectiveness ratios of MI techniques.

4. Discussion

This study aimed to assess the feasibility of a randomised controlled study testing the effectiveness and implementation of a Motivational Interviewing (MI) intervention for weight-related behaviour change in obesity. The results showed around 50% retention of participants to the trial, and high participant drop-out within the control group in particular. Issues with attrition in weight loss interventions are reported in the literature (Moroshko et al., 2011) and some research with patients has identified multiple reasons for dropping out of trials including personal or work problems causing practical difficulties, comorbidities and poor relationships with the interventionist have been reported (Grossi et al., 2006). The current study provided a link for participants to withdraw from the study and optionally provide reason for withdrawal. However, no participants completed this form. In other literature of health interventions for smoking cessation, control group participants reported feeling very disappointed that they were allocated to this condition and withdrawal of consent was slightly higher for control participants (Lindström et al., 2010).

The intervention met recommended proficiency levels for use of MI skills, and it was possible to develop an understanding of the precise content of MI sessions further by using taxonomies of behaviour change techniques. Descriptive statistics showed increases to participant MET minutes and improved wellbeing from baseline to follow-up for both groups. However, the small sample size limited the ability of the intended analyses to assess effectiveness of the intervention in comparison to the control condition. There appeared to be a relatively even divide in use of relational and content-based techniques present within interventions, and effectiveness ratios demonstrated that there were several techniques which attained high effectiveness ratios, suggesting they were more frequently present in successful interventions when examined on a per-participant basis. The recruitment, which was predominantly approached through social media advertisements and connections with patient-led advocacy groups, was successful. Participants were recruited primarily through links with patient support networks who advertised the study in their private groups and wider social media on publicly viewable pages. Most interested individuals were eligible to take part and an acceptable sample was reached for the coding component of the study. 60 participants (30 participants per arm) were

expected to be recruited to the study. It was anticipated that this would provide an appropriate sample size for future sample size calculations and that completing up to 90 hours of interventions over the study period was feasible to complete. Additionally, existing research (Hooper, 2019, Juluous, 2005) recommended that a minimum of 12 participants per group, or an overall total sample of 30 participants, may be sufficient to calcuate the power of the trial and future sample size calculations (Donald, 2018, Lancaster, Dodd, & Williamson, 2004, Browne, 1995). Therefore, accounting for the potential retention of 50% of participants, targeting the recruitment of 60 participants was expected to allow for evaluation of the intervention effectiveness and to inform sample size calculations for future work. As reported in Chapter 6, due to the feasibility nature of the trial it was anticipated that the study may be underpowered for statistical testing. This sample size was not reached, meaning that the planned analyses to evaluate the effectiveness of the intervention in comparison to the control group, and to examine its power, were not possible. However, the study provided useful information regarding the design of a future trial such as the methods of delivery, issues with participant retention, and approaches for analysing the techniques utilised within an MI session to support weight-related behaviour change.

The study experienced a high rate of participant drop-out. Where participants did not join scheduled sessions, the PhD researcher (HM) attempted to reschedule the meeting. Contact attempts by email and telephone were made twice before considering the participant withdrawn. Participants were also offered the opportunity to fill out the questionnaires but not complete the session, if preferred. Additionally, at the bottom of reminder emails, participants were provided with a link to follow to a short survey where they could confirm they wished to withdraw and provide a reason for this. However, no participants completed this form.

A number of factors may have contributed towards the number of participants who were lost to follow-up. Firstly, use of the control condition as an information-only comparator session may have influenced participants choosing to exit the study. To try and reduce attrition, the control condition was set up to allow participants to click through the video without watching all information. However, this did not appear to be effective at retaining participants in the control condition to complete the

study surveys. Use of an alternative control format, such as a waitlist control, may have been more appropriate for retaining participants who were interested in completing the MI sessions.

Secondly, recruitment of participants initiated during a period of local and national lockdowns within the UK. Whilst no participants completed the withdrawal feedback form that was included at the bottom of reminder emails, anecdotally, several participants referred to situations and responsibilities related to the workload that impeded their involvement in the study, for example, work patterns, childcare and caring for family/friends. Thirdly, the study was designed with the intention of running remotely, including data collection. This was to protect both the researcher and the participant during COVID-19. However, this appeared to not be an effective method of collecting data from participants. Some participants anecdotally reported forgetting to complete the link. An alternative approach to collect this data could be to complete it whilst on the call with the participant so that any technical issues could be mitigated, or for another member of the research team (such as the PhD supervisor) to contact the participant and complete the questionnaire via phone call. Future research should also speak with participants in order to understand what they did or did not like about the study design to help improve retention.

Meta-analyses of motivational interviewing interventions applied within obesity and weight-related contexts (Armstrong et al., 2011) have previously suggested that the reporting of intervention content was a limiting factor in understanding its efficacy. Other recent reviews of MI for weight-loss outcomes have reported that alongside issues in content reporting, a lack of focus on the fidelity of MI means it is even more difficult to confirm what is occurring within this context (Barnes & Ivezaj, 2015). The current study demonstrates it is possible to provide a detailed breakdown of the components of this complex intervention, including the duration and quantity of MI delivered. Reviews of MI within obesity management have found it has great potential for improving behavioural outcomes, but fidelity of the approach may be an issue when implemented in practice (Christie & Channon, 2014). The current study has reported fidelity, meaning it is clear what intervention was being applied, and how it adhered to the spirit of MI. The use of an MI-specific taxonomy (Hardcastle et al., 2013, 2017) was also an acceptable method of summarising what

occurred within sessions. Whilst this may be an appropriate intervention for behavioural change, the current study was unable to develop formal conclusions regarding effectiveness due to limited statistical power.

An important aim of the current study was to assess the feasibility of the study design for future research focusing on the effectiveness of this approach. This appeared to be an effective method to use for establishing the content of interventions as coding was accurate and led to clear specification of what occurred within the sessions. Other coding studies have intended to identify effective behaviour change techniques for adults living with obesity (Smith et al., 2016). Smith and colleagues used thematic analysis to code three techniques most frequently used; self-monitoring of behaviour, prompts/cues, and unspecified social support. McDermott and colleagues used a taxonomy specific to healthy eating and activity to code interventions within a systematic review (McDermott et al., 2016). One technique, provide information on the consequences of behaviour in general, was significantly associated with a positive change in behavioural intention. Cradock and colleagues completed meta-analyses of behavioural interventions focusing on diet and physical activity, and found that action planning, instruction on how to perform the behaviour, and behavioural practice/rehearsal (Cradock et al., 2017) were positively associated with improved health outcomes at three and six-months. However, this was not sustained to 12 and 24 months. This suggests that there may be important considerations when designing studies to have long-term benefits for individuals in maintaining health behaviour changes over time.

There were important limitations to highlight which could be resolved in future studies. Data collection was conducted remotely using self-report methods. Therefore, it is possible that the data obtained was not reflective of participant activity levels or true eating behaviour. Whilst the IPAQ is a widely used tool, a systematic review of validation studies found generally poor validity of the tool compared to other objective activity measuring devices (Lee et al., 2011). There were issues with completion of survey measures, potentially due to the remote and technological components of this data collection. Future studies could identify more pragmatic approaches to survey completion, such as telephone follow-ups with a researcher not involved with intervention delivery. However, the data

collection methods were appropriate for use during national lockdowns as they permitted participants to complete the forms remotely. Alternative measurements, such as waist circumference and observer- or clinician-rated outcomes of physical activity abilities could be considered as a progress outcome.

The intervention was delivered by a single researcher which may not be the format of delivery in practice. Future studies could utilise multiple MI interventionists to attain a greater spread of techniques and enhance examination of effectiveness. Although sessions should be tailored to the individual's needs, an understanding of what techniques are present and effective among a larger sample of practitioners is beneficial for developing effective interventions. In terms of the second research question, which aimed to investigate the effectiveness of the approach, low participant numbers limited the appropriate statistical analysis to investigate changes longitudinally.

Finally, researchers should interpret the present findings regarding effectiveness with caution, considering the small sample size and infrequent presence of some 100% effective techniques. Future studies could explore the groupings or pairings of techniques that are delivered across interventions, to determine if there is a particular structure that enhances effectiveness: for example, greater utilisation of engagement techniques or action planning in earlier sessions in comparison to later sessions. The individualisation of behaviour change interventions means that efforts can be made to tailor BCT use throughout the process. The intended analyses could not be completed due to small sample size, meaning that effectiveness of the intervention could not be established. Although the planned analysis could not be completed the primary focus of the study was to establish the appropriate methods and feasibility of delivery of the study intervention for a future trial to establish effectiveness. These aims were met through the study, however, it is important for a future trial to meet the intended sample size that permits quantitative evaluation of the intervention.

It is important to consider the impact of the contextual circumstances within the current study, as recent research has shown that mental health and health-related behaviours were negatively impacted during the first COVID-19 lockdown pandemic (Brown et al., 2021). Survey studies have shown that people living with obesity reported reduced physical activity, less healthful dietary intakes, increased overeating and poorer sleep patterns throughout the course of the pandemic (Brown et al.,

2021, Robinson et al., 2021). There is a need for interventions that can provide ongoing support during times of disruption such as the pandemic and other circumstances.

In sum, a randomised controlled trial was delivered, which aimed to compare the delivery of three sessions of Motivational Interviewing in comparison to an information-only condition. This was intended to permit the analysis of the content of this complex intervention and elucidate which elements occurred more frequently within interventions that led to improvements to participant-reported outcomes of goal attainment. Results showed several techniques were frequently present in interventions interpreted by the participants as successful; goal-setting of outcomes, feedback on behaviour, and information about antecedents. Furthermore, a specific taxonomy of MI-specific techniques was included, showing that the techniques of permission to provide advice and information, undershooting, and review of outcome goal. were present across successful interventions. Content analysis indicated that relational/content-based techniques were particularly present. Future studies should include this content reporting approach as it will more clearly represent what is happening within the intervention.

Chapter 8. General Discussion

Foreword

The overall aim of this thesis was to establish the effectiveness of Motivational Interviewing (MI) within the context of obesity and weight management, and to clarify the theoretical mechanisms of this complex behaviour change intervention. Chapter-specific discussions and interpretation of results can be found in the relevant empirical chapters. This chapter provides a summary of the key findings and interpretation in light of previous research and the PhD aims. To summarise, the research identified several techniques that are potentially effective mechanisms underpinning a MI approach to providing behaviour change support.

MI may be a beneficial approach within overweight and obesity settings, and thus further research was required to address the methodological problems identified by a systematic review and to confirm the most likely mechanisms of action related to this complex intervention. Use of MI within healthcare was considered an effective relationship-building approach to change discussions by practitioners from varied settings. MI allowed plans to be developed according to the patient's own goals and ideas, although practitioners noted importance for guiding this to shape appropriate and feasible actions. However, opportunities for further training and supervision were desired alongside a working environment that supported changes to practice. Empirical research was able to provide additional support for use of specific techniques developed for clarification of the content of MI interventions and identified that the techniques intended to support engagement within behaviour change conversations were particularly frequent in an MI approach. The implications of these identified techniques and utility of the findings for policy and practice are discussed in further detail.

1. Overview of thesis aims

The overall aim of this thesis was to identify the underpinning theoretical mechanisms of Motivational Interviewing (MI) using a taxonomy of replicable techniques to aid understanding and inform knowledge of *how* MI can be used to support behaviour change. Furthermore, to achieve this overarching aim, the research completed intended to clarify *what* MI skills were applied in other research and in real-life healthcare practice from the perspectives of research and practitioners, and to test an MI intervention for weight-related behaviour change in the context of obesity. The aims of each discrete study are reported in Table 16.

Table 17. Summary of studies described in thesis.

Study	Design	Study aims	Sample size	Participant characteristics	Intervention	Comparator	Outcome of interest	Main findings
1	Systematic review	To investigate the effectiveness of MI for adiposity outcomes in populations with obesity aiming to lose bodyweight. To evaluate the effectiveness of MI using meta-analytic methods. To report the presence of BCT and MI-specific techniques. To report the theoretical underpinnings described in MI research to inform understanding of how it is utilised.	N/A	N/A	N/A	N/A	BMI, bodyweight, physical activity behaviour, eating behaviour	No statistical evidence of effects of MI for bodyweight outcomes but potentially effective for behaviour changes
2	Qualitative study	To understand what practicing health professionals who have received training in MI	14	Patient-facing healthcare practitioners with experience of receiving training in	N/A	N/A	N/A, exploratory	Five themes were identified by thematic analysis including (1) Building

Study	Design	Study aims	Sample size	Participant characteristics	Intervention	Comparator	Outcome of interest	Main findings
		currently understand it to involve when utilised in their professional role, in terms of the a) skills, b) delivery format, and c) underlying mechanisms of effectiveness. To understand how MI is perceived by practicing health professionals to support health-related behaviour change in their patients.		MI and experience in health behaviour change support through their professional role				competence in MI, (2) Integrating MI into practice, (3) When to use MI, and when not to, (4) Impact of the external environment, and (5) Enabling a deep understanding of the person and their strengths. Practitioners considered MI as an appropriate method of offering individualised support for behaviour change that allowed them to work in collaboration with their patients. In particular, interpersonal factors were considered crucial.
3	Single-group intervention study[a]	To investigate if MI is an effective intervention to improve participant's behavioural determinants (capability, opportunity, and motivation) of engaging in a specific health-	32	Adults (≥18 years) with an interest in increasing their physical activity behaviour levels	Up to 3 x individual 60-minute MI sessions	N/A	Physical activity behaviour, behavioural determinants	Significantly increased confidence, motivation, and automatic motivation to take part in more physical activity, however, no significant changes to physical activity outcomes.

Study	Design	Study aims	Sample size	Participant characteristics	Intervention	Comparator	Outcome of interest	Main findings
		related behaviour change (increasing physical activity). To identify which specific techniques from the BTTv1 and MI-specific content-based and relational techniques as defined by Hardcastle and colleagues (2017) were present in effective MI interventions where participants increased their physical activity.						
4	Randomised controlled feasibility trial[a]	To investigate the feasibility of recruitment processes, intervention delivery, and retention of participants to a MI research trial for weight-related behaviour change in the context of obesity. To identify any required changes to	32	Adults (≥18 years) with an interest in making any kind of change to a self-identified weight-related behaviour	Up to 3 x individual 60-minute MI sessions	Up to 3 x 45-minute video sessions with general lifestyle and wellbeing guidance in line with NHS recommendations	Physical activity behaviour, eating behaviour (addiction-like eating behaviour, fruit intake, vegetable intake), wellbeing, behavioural determinants	Feasible delivery of MI using remote methods, recruitment method appropriate, high participant drop-out, and nested coding study able to identify specific techniques and mechanisms of MI skills used within context of weight-related behaviour change.

Study	Design	Study aims	Sample size	Participant characteristics	Intervention	Comparator	Outcome of interest	Main findings
		be made in preparation for future MI trials. To examine if MI is likely to be an effective individual intervention for weight-related behaviour change in an adult sample with obesity, in comparison to the provision of information only (comparator). To identify the relational and technical factors present in successful individual-level MI interventions within this sample.						
[a]Part or all of this study took place during COVID-19 restrictions including national and/or local restrictions such as stay-at-home requirements, closure of public leisure, education and workplace settings, and restrictions on social contact								

2. Summary of empirical findings

The studies reported in Chapters 3, 4, 5, and 7 showed that a number of techniques were frequently reported. From the BCTTv1 taxonomy (Michie et al., 2013), these techniques were *setting of goals* for behaviour change and behaviour outcomes, and the provision of information (e.g., *information about antecedents,* and *information about the health consequences* that would follow from maintaining the status quo behaviour). From a list of MI-specific techniques developed by Hardcastle and colleagues (Hardcastle et al., 2017), the most frequently reported techniques within interventions were *open ended questions, affirmations*, and *reflections*. Furthermore, in the intervention studies, *permission to provide advice and information, undershooting,* and *review of outcome goal* were also identified within interventions considered 'successful'. This indicates that the content of interventions using an MI approach includes both the content-based, replicable factors but also relational elements that reflect the ethos of MI. There has been poor reporting of this complex interventions' contents in research more generally. Use of taxonomic methods has provided a clearer understanding of what happens in MI sessions and supports the potential for replication of studies. The findings indicate that MI supports behaviour change through a combination of techniques that are clearly intended to evoke change discussion and forward planning, as well as emotional and social support through rapport-building and relational techniques.

Several hypotheses of MI have been researched. Three hypotheses are known as the technical hypothesis, the relational hypothesis and the conflict resolution hypothesis (Magill & Hallgren, 2019; Romano & Peters, 2016). A systematic review and meta-analysis found support for the technical hypothesis, but not the relational hypothesis of MI (Copeland et al., 2015). Other systematic reviews have lent support to the technical hypothesis of MI (Magill et al., 2014). However, the empirical studies completed indicate that the relational component of MI intervention is also important for supporting behaviour change. Firstly, within the qualitative research study with healthcare professionals (Chapter 4), the relational element of MI was described as creating rapport between the professional and patient, which could be used as the foundation to explore and plan for behaviour change. Secondly, within the nested coding studies (Chapters 5 and 7), the relational techniques of MI

were prominently coded, which demonstrates they are an important element of MI as it is delivered in practice. This is similar to other findings examining the relational and technical content of MI, which has suggested that both aspects are important for successful outcomes (Villarosa-Hurlocker et al., 2019). The theoretical implications of the findings are discussed in further detail in section 3.

3. Theoretical implications of empirical findings

Research was required to establish what the underlying mechanisms of MI are as delivered to support individuals with behaviour change. The intention of this thesis was to develop a solid base of evidence for the use of MI within a health-related context. The relational techniques used within MI may provide some explanation for its mechanisms (Hardcastle et al., 2017). The approach to establishing the active components of MI involved mapping the intervention onto a widely used taxonomy of behaviour change techniques, the BCTTv1 (Michie et al., 2013). Defining MI using techniques from this taxonomy was intended to further understanding of how MI effectively causes behaviour change and assist in the creation of future MI-based interventions. The following sub-sections will discuss the findings in light of the research aims.

3.1. What are the underlying mechanisms of MI?

The primary research question of this thesis was to identify the underlying mechanisms of MI. A set of discrete, but linked research studies were consecutively developed in order to provide clarity on the components of MI that could be used to produce effective behaviour change within health contexts. The need for this research is in line with recommendations from the Medical Research Council (Medical Research Council, 2008) to ensure that behavioural interventions are effective, replicable, and deliverable.

The first important step was to conduct a systematic review of the relevant literature. One aim of this study was to clarify what previous research suggested the relevant mechanisms to be. Some, but not all, interventions were theoretically informed. The content of interventions that was reported within published study articles, appendices and protocols was examined for behaviour change and MI-specific techniques. Coding of the content showed that the most frequently present techniques

were *unspecified social support,* and techniques from the *goals and planning* or *feedback and monitoring* categories such as *self-monitoring of behaviour, problem solving, goal setting* and *information about health consequences*. The coding approach was assessed for inter-rater reliability, which confirmed the findings were reliable. However, there were issues in the reporting of content which made it difficult to confirm if the interventions that were being delivered under the label of MI were truly MI. Other research has consistently called for more in-depth clarification of intervention content to aid with the replication of research (Michie et al., 2013). Coding the intervention descriptions was challenging which suggests the recommendations of earlier research have not been regarded.

3.2. What are the theorised mechanisms of MI from a HCP perspective?

Based on the findings of the systematic review and meta-analysis (Chapter 3), the most frequently utilised theoretical approaches were *Transtheoretical Model/Stages of Change, Self-Determination Theory,* and *Social Cognitive Theory,* suggesting that researchers believed behaviour change to be directed by a number of determinants such as confidence and self-efficacy, social norms, support, and opportunity, and knowledge. However, the reporting of intervention content was found to be generally poor within published articles. This meant it was challenging to identify and interpret the specific components of MI when utilised for weight-related behaviour change in the context of adult obesity (Michie & Johnston, 2012); further research was needed to understand the practical application of techniques to support change in behavioural determinants. To address this, a qualitative study was designed in order to understand what healthcare professionals who had received training in MI understood it to involve in terms of the *skills*, *delivery format*, and *underlying mechanisms* of supporting behaviour change.

Perspectives of those working within healthcare settings with experience of behaviour change interventions and conversations as a part of their working practice were collected. This is an important element of the thesis and overall research as it provided rich insights into how practitioners, who deliver the intervention, feel it works in their practice. The findings suggested value in MI for the

HCPs as well as their patients; HCPs reported they felt it was easier and more effective to do their jobs using an MI consistent approach.

Thematic analysis of interview transcripts with 14 healthcare professionals generated five key themes to explain the application of MI to professional healthcare: *building competence in MI, integrating MI into practice, when to use MI and when not to, impact of the external environment* and *enabling a deep understanding of the person and their strengths*. These themes showed that practitioners considered MI to include interpersonal skills to cultivate a conversational style that built rapport and respected patient autonomy, described as the 'spirit' of MI by Miller and Rollnick (Miller & Rollnick, 2013). MI skills were frequently used during consultations involving behaviour change support, and practitioners highlighted that the relational element of MI was vital. The process of feeling competent to practice in MI skills has also been described in sports-specific qualitative research (Mack et al., 2017); participants considered it challenging to develop skills to a level of confidence and competency. Practitioners valued being able to promote autonomy, as this was considered to support implementable, achievable plans. This sentiment has been echoed by qualitative research from the patient perspective (Brobeck et al., 2014).

3.3. Is MI an effective intervention to support behaviour change?

The first empirical chapter (Chapter 3) systematically reviewed the available literature and combined the findings using meta-analysis. This demonstrated that MI was not significantly more effective than the comparator condition for adiposity-specific outcomes, suggesting there was no weight loss above and beyond that reported in the comparator condition. In comparison to previous research, the findings were not in line with a recent meta-analysis that adopted similar inclusion criteria, namely the application of MI within weight-management which found a significantly greater reduction of bodyweight in patients with overweight and/or obesity (Armstrong et al., 2011). This is potentially due to discrepancies in the use of standard error and standard deviation statistics within the random effects model within earlier research. However, like other studies reviewing the literature of MI for behavioural outcomes rather than adiposity-focused measurements, MI may have promise for supporting change (Knight et al., 2006).

After establishing that several techniques were frequently reported within the body of relevant literature, and identifying the views of individuals working in healthcare practice as to how they considered it to work in behaviour change support, the next research study was developed to empirically test an MI intervention. In real life practice, individuals receive healthcare support for a wide range of health behaviours, not limited to a specific goal or outcome measurement. This is reflective of the heterogeneity within our biology, genetics, social position, environmental setting and psychological and historical experiences. Therefore, testing the intervention in practice invited adult participants with a wide range of physical activity-related goals to receive up to three sessions of MI support. By recording the audio, it was possible to confirm which techniques were found within an MI-consistent approach delivered by two interventionists.

3.4. What specific techniques are appropriate for use within an obesity context?

The previous empirical chapters informed the development of a single-group, pre-test post-test intervention study (Chapter 5). The aims of this study were firstly test the effectiveness of MI at supporting change to the theorised determinants of behaviour: capability, opportunity, and motivation, and at increasing a specific domain of behaviour: physical activity. The findings of this study were that combined behavioural determinants score significantly increased from the baseline to final measurement. This was driven by a significant increase in confidence, motivation, and automatic motivation. However, physical activity scores were not significantly different between baseline and final measurement timepoint. Secondly, the study was designed to include a nested coding component to identify what techniques were present on a per-participant basis during interventions where participants successfully increased their physical activity behaviour. The results of the coding component showed that the following techniques were frequently present in these sessions: *action planning, behaviour goal setting,* and *review of behavioural goals,* whilst the most frequently occurring MI-specific techniques were *open-ended questions, reflective statements, summary statements, agenda mapping,* and *affirmations.*

Meta-analysis of studies implementing MI for PA increases (a weight-related behaviour) within populations with chronic illness identified that it had significant, but small effects in comparison to

non-MI groups (O'Halloran et al., 2014). The authors noted that improvements were more likely to be identified in studies utilising tools that confirmed the fidelity of treatment delivered to what was intended. Other research has used a coding approach to examine the content of MI and other therapeutic approach sessions. Coding for physical activity outcomes was completed by Gagnon and colleagues (Gagnon et al., 2018). They confirmed that the MI-specific list of techniques was appropriate for use within counselling sessions to clarify session content. However, Gagnon et al (Gagnon et al., 2018) did not examine the efficacy of MI for physical activity behaviour change, as this study focused on testing use of the list of MI techniques. Therefore, the empirical research reported in Chapter 5 presents a novel investigation into the feasibility of testing MI as an intervention to support increases to physical activity levels, whilst also permitting the design of a study that could assess feasibility of the approach. The findings were impacted by the pandemic, but preliminary findings suggest improvements to behavioural determinants of change, indicating that increases to physical activity behaviour may have followed.

Whilst the single-group study reported in Chapter 5 indicated which techniques were frequently present in interventions that resulted in significantly greater behavioural determinant scores, an important aspect of the present research is to understand what approaches work best for people with obesity. Individuals with obesity may be interested in other behaviour change goals, such as eating behaviour, social or other behaviours, or identifying other forms of support (e.g., identifying options for receiving specialist support with weight management). Therefore, Chapter 7 investigated an MI intervention in comparison to an information-only condition. This study was designed to allow for investigation of the feasibility of a randomised controlled trial (RCT) in terms of the recruitment approach, delivery in an online-only format, and retention of participants to a randomised controlled trial. This was intended to demonstrate if this was feasible for a larger research trial or if changes were needed to the design of the study. Furthermore, some meta-analyses have suggested that MI is more effective when directed at a single behavioural change rather than multiple health behaviours (Armstrong et al., 2011). Whilst Chapter 5 investigated a specific behaviour change goal (increases to physical activity), Chapter 7 provided an opportunity for testing the intervention with a range of

different goals across the sample, which may be more realistic to the application of MI and behaviour change support in everyday practice settings. Participants were able to enter the study with *any* kind of weight-related behaviour change goal, for example changes to eating behaviour or to physical activity behaviour. This approach is in line with the person-centred and autonomy-promoting principles of MI. The study also aimed to identify the relational and technical factors which were present in successful interventions at the MI level within this sample of adults with obesity. The findings of this study indicated that physical activity duration increased and wellbeing scores improved for both groups. However, the study experienced high rates of drop-out and the findings should be interpreted cautiously due to small sample size. The nested coding component of the study found that the most frequently reported BCTs were *behavioural goal setting, comparative imagining of future outcomes,* and *framing and reframing* techniques. Within interventions where participants reported they were making good progress with goal attainment, the most commonly applied techniques were *goal-setting of outcomes, feedback on behaviour,* and *information about antecedents.* The most frequently coded MI-specific techniques were *open-ended questions, reflective statements, affirmations* and *summary statements* across all sessions, and *permission to provide advice and information, undershooting,* and *review of outcome goal* within interventions considered 'successful'. This will support future research in being able to replicate findings by providing clearer content reporting (Jelsma et al., 2015). The findings of this chapter suggest that it is feasible, acceptable for participants, and potentially effective to use MI within this context.

The approach to coding included my PhD supervisor, another PhD researcher in the Psychology department, and external practitioner Health Psychologists reviewing audio tapes of the MI sessions that I completed. This was to identify the behaviour change techniques and to provide ratings on the consistency of MI skill and technique use (assessed using the MITI). During the study period, to learn and develop my MI skills and approach to the intervention sessions, I held regular supervision meetings with my PhD supervisor. These meetings provided an opportunity to discuss any aspects of the intervention that had felt complex and consider the appropriate techniques to use that would be most helpful for the conversation with the participant. I found this to be an effective method of

reflecting on my skills during the study period and provided a useful feedback mechanism for my MI skill development as it allowed for external input using a real-life example.

4. Practical implications

The findings of the empirical chapters suggest that MI could be implemented to support behaviour change, based on the improvements to self-reported behavioural determinants (Michie et al., 2011). It also appears feasible to evaluate the intervention within a larger clinical trial format, which would provide further evidence of effectiveness using a gold-standard research design. MI allows for an individualised approach to support (Murray et al., 2017). Furthermore, healthcare professionals reported that MI was a benefit to their professional practice in that it provided structure and autonomy to patients. The mechanisms of MI have been clarified using the coding methods reported in the thesis. Techniques from the *goals and planning* and *feedback and monitoring* groups of behaviour change techniques (Michie et al., 2013) appear to hold promise for the development of effective interventions.

There were learnings from the empirical studies that can be applied to healthcare professional (HCP) practice. MI may be effective for behavioural outcomes that are related to bodyweight, such as physical activity and diet. The qualitative investigation demonstrated that HCPs considered MI to support patient-centred approaches to care and the development of a deeper understanding of the patient and their values. Additionally, practitioners considered MI to provide a helpful structure and base for their own interactions with patients. This enhanced their sense of satisfaction with their job role. The techniques of *goal-setting of outcomes, feedback on behaviour* and *information about antecedents* may be particularly effective as they were more frequently present within interventions considered successful from the perspective of the patient. However, other research has also reported that MI introduces new demands on HCPs in learning and consistently applying MI skills (Brobeck et al., 2011; Shannon et al., 2017). MI may be a helpful style of communication when adequate training and support for implementation is available. Without endorsement of the approach from others in their organisation (such as their work teams and management), it may not be a sustainable change for HCPs (Lim et al., 2019).

Person-centred care has been endorsed by national health bodies in the UK (Department for Health and Social Care, 2013). Current training of the healthcare workforce recommends person-centred approaches are a part of best practice for illness prevention, patient care and wellbeing support (Health Education England, 2017). The adoption of the spirit and ethos of MI (Moyers, 2014) by healthcare staff meets this recommendation. It is also vitally important that HCPs recognise the complexities of each individual experience with obesity, and the external factors that contribute towards obesity development and bodyweight maintenance. For the past several decades, governmental policy has adopted both individual-level and population-level interventional approaches to obesity (Theis & White, 2021). However, the current prevalence of obesity suggests that to date, these attempts have been largely ineffective at reducing the rates of obesity. Greater implementation of population-level interventions that target the environmental factors relevant in bodyweight, such as portion size, advertising of food and drinks, and accessibility of physical activity opportunities (e.g., recreational spaces) or active transport options (e.g., safe spaces for pedestrians) (Bryant et al., 2015; Lakerveld & Mackenbach, 2017) may also be effective interventions that could be implemented for the wider population.

5. Research implications

Theoretically, autonomous motivation may be associated with behavioural and bodyweight outcomes. It is a predictor of effective self-regulation in a number of relevant behaviours including weight management, eating behaviour, weight loss, and weight loss maintenance (Teixeira et al., 2006; Teixeira et al., 2015). Individuals with obesity who participate in weight loss interventions may be more likely to adhere to the intervention and maintain weight loss over the follow-up period if they have more autonomous motivation (Williams et al., 1996). Other research has shown that higher levels of controlled regulation (feeling there are other reasons or motivations to do something, such as to avoid punishment) at baseline were associated with reduced weight loss within an intervention, whilst increases to autonomous regulation (considering tasks to be inherently interesting or enjoyable) are predictive of greater weight loss at 6-months (Gorin et al., 2008). As an approach for behaviour change, MI is designed to reduce ambivalence or confliction about a behaviour through engaging and

building rapport, identifying the area of interest to the individual and then working alongside to develop plans.

MI intends to evoke individual reasons for change, such as why it would be important to the individual; this may increase their perceptions of control over the behaviour. Perceived behavioural control may predict action within physical activity behaviours (Plotnikoff et al., 2013). The intervention to support physical activity behaviour change reported in Chapter 5 identified significant increases to confidence, reflective and automatic motivation; however, there did not appear to be any change to physical activity levels over the course of the intervention. Although some of the determinants of behaviour increased, this was not followed by changes to the behavioural outcome. This could potentially be attributed to a number of participants dropping out of the study, impacts to the opportunity to participate in physical activity, and other related disruptions due to the COVID-19 pandemic. Due to the small sample size in Chapter 7, it was not possible to conduct further analyses to explore the effectiveness of the intervention as the study was not adequately powered for this.

Within weight management, a number of techniques appear to mediate the gap between intention and action (Sniehotta et al., 2004). This includes self-efficacy, self-regulation strategies, and planning the steps necessary for a specific behaviour. Three studies (Chapters 3, 5, and 7) explored the most frequently identified techniques within MI interventions in weight management contexts. Within Chapter 3, the most frequently identified techniques were from the goals and planning and feedback and monitoring groups (*goal-setting of behaviours* and *self-monitoring of behaviours*). In Chapter 5, the most frequently identified techniques were within goals and planning (*action planning, behaviour goal setting, and review of behavioural goals*). In Chapter 7, the most frequent techniques included *action plans, behaviour goal setting, comparative imagining of future outcomes, framing/reframing,* and *review of behavioural goals*, which are from the goals and planning, comparison of future outcomes, and identity groups. These techniques may be particularly relevant for weight management interventions as they are strategies for planning behaviour and supporting self-regulation.

Meta-analysis of over 180 datasets (Ng et al., 2012) examined a number of psychological constructs that may be associated with health outcomes in the context of behaviour. Practitioner

support for patient autonomy and patient experience of psychological needs (autonomy, competency, and relatedness) being met were moderately predictive of protective health behaviours, including physical activity levels. The findings from the qualitative study in Chapter 4 demonstrated that practitioners felt MI supported patient autonomy through *'coming alongside'* to collaborate with the patient. Considering that the approach promotes autonomy and emphasises the importance of rapport-building and engagement between the practitioner and patient, MI may be one appropriate approach for weight management. Fidelity assessments of the intervention session content completed in Chapters 5 and 7 showed that the relational skills met recommended cut-offs for 'good,' suggesting that focus on empathy and rapport-building was evident. However, although outcomes trended in the expected directions, no significant improvement to physical activity levels (Chapter 5 and Chapter 7), nor eating behaviour and wellbeing (Chapter 7) was identified.

There are several recommendations for future research opportunities. Chapter 7 was developed to examine the feasibility of a randomised controlled trial testing MI in comparison to the provision of information-only. The feasibility outcomes indicated that it was possible and effective to recruit through links with University and local community networks (e.g., mailing lists, online posters and word-of-mouth), and through connections with private support groups and networks who shared the advertisement with their group members. Five individuals were screened out during recruitment, suggesting the study advertisements were effective at identifying and inviting individuals who met recruitment criteria. The randomisation methods were effective in allocating participants to either the intervention or comparison condition. Use of tools that aid intervention design and replication, such as the template for intervention description and replication checklist and fidelity assessment tools, are recommended elements of research planning. Recommendations for future research are further discussed in sections 6 and 7.

6. Strengths and limitations

There are several important limitations to report related to the design and delivery of the empirical research studies. Firstly, the populations recruited to interventional studies in Chapters 5 and 7 were not representative of obesity within the UK population. Most participants in both studies were female.

Whilst obesity prevalence trends slightly higher in females than males in the UK (Corfe & Shepherd, 2021), the obesity rate for females is 29% compared to 27% of males. Therefore, to ensure that the intervention studies are relevant to the target population, the samples should have obtained roughly similar representation. However, this limitation is not unique to the present study. Much psychological research struggles to recruit men to participate in research studies (Ryan et al., 2019). In Chapter 5, this was believed to be a result of the recruitment period closing due to the lockdown. This meant that recruitment had advertised within the University Psychology department, which had a high number of female undergraduates. Participants who were undergraduate Psychology students were enrolled in return for course credit. The next planned stage of recruitment was to advertise more widely around the University community and general public. Due to the lockdown, this was not possible in order to protect both researchers and participants as the COVID-19 lockdown situation was evolving. An additional issue faced with recruitment is that the requirement to take part in studies for course credit on the undergraduate course was waived, which may have been an incentive for participants to sign up.

Future research into support for weight-related behaviour change should adopt alternative recruitment techniques to overcome this challenge. Other approaches could be considered to support the recruitment of participants. Firstly, a future study could consider several options for the recruitment of male participants. This would be important to consider as the rates of obesity in men (11.1%) are not dissimilar to women (15.1%; Kim & Shin, 2020). Research (Ryan et al., 2019) has pointed towards a marked difference in the likelihood of men responding to online research study advertisements. Use of targeted advertising, such as social media tools that incorporate evidence-based components that appeal to men, appeared to increase engagement with the advertisement. This may be one approach to improving the reach of the recruitment advertisement to this population. However, the researchers noted that a form of snowball sampling was also necessary to boost enrollment of men to the study. The studies reported in Chapters 5 and 7 did not actively utilise this method of recruitment. A future study using similar methods may benefit from asking participants to circulate the study advertisement with potential male participants from their networks.

Additionally, the research studies would have benefitted from involvement from the public and patients (PPI). Patients can be engaged throughout the research process including the identification of research priorities, improving access, explaining the study, exploring participant experiences, and dissemination and application of the research findings (Sacristán et al., 2016). The advantages of PPI are that it can provide feedback on an early stage regarding the methods and approach to data collection, lead to novel ideas and provide insights that may not be obtainable without support from PPI.

Secondly, due to wider contextual factors, the intervention studies took place during the initial waves and lockdown of the COVID-19 virus in the UK. This meant that participants were subject to stay-at-home legislation and the closure of schools, universities, and public leisure locations such as gyms (Baker et al., 2023). The recruitment and data collection efforts may have been affected by changes to usual behaviours. The studies were carried out predominantly online using remote video-calling or telephone interviews. This may have affected the development of rapport between the participant and interventionist, although some research has suggested that remote delivery is as effective as in-person delivery (Markowitz et al., 2021) and this approach was required to minimise the risk of harm to both participants and researchers.

A number of other limitations may have resulted from this approach. Firstly, use of online compared to in-person formats introduced additional, practical issues during recruitment, the intervention delivery, and data collection that would not have been present through in-person delivery, for example, IT or internet connectivity-related issues. As recruitment was conducted through online methods, only individuals with access to the internet were able to see the study advertisement. Furthermore, any issues with completing the study questionnaires, such as technical difficulties with the webpage or queries about the forms, could not be answered in real-time, as would have occurred if the intervention and data collection had taken place in person. However, this also meant that the recruitment could target a larger geographical area, as participants were not required to be within the Liverpool region to be able to travel to the University to complete the intervention.

In addition to the recruitment challenges experienced, there were high drop-out rates of participants in the comparator condition. This was despite efforts during research design to support the retention of participants in this group including making the randomisation approach clear during recruitment. Furthermore, participants were invited to provide reasons for withdrawing from the study. However, no participants who left the study provided further information. This also resulted in an underpowered sample for planned analyses as reported in Chapter 5. To enhance retention of participants, use of reimbursements for their time taking part may have encouraged participants to engage with the study. However, use of incentives or payments for taking part in the study could therefore be construed as a financial incentive for the behaviour change. One review identified that financial incentives were more effective than usual care or no intervention for encouraging changes such as smoking cessation, vaccination adherence and screening, and physical activity (Giles et al., 2014). Another option to resolve recruitment challenges could be to extend the recruitment period of the study.

There are some theorised reasons that participants may leave the study. For example, those who dropped out of the study from the intervention group may not have found the intervention to meet their needs, or to have had poor rapport with the interventionist. This is reflective of in-practice experiences of behaviour change support. Future trials could utilise multiple interventionists to deliver the sessions in order to test inter-interventionist differences. Additionally, the implementation and efficacy of MI training is an important area of research to understand what should be considered to ensure interventionists feel competent and confident in their skill use. However, this was beyond the scope of the current thesis.

Thirdly, the applicability of findings to obesity-related interventions is also affected by the disruptive nature of the pandemic. The first intervention study (Chapter 5) did not include weight or BMI eligibility criteria and the average BMI of participants was below cut-offs for overweight or obesity. During the first wave of data collection, other social factors such as impacted food supply chains (Hobbs, 2020), limits on the distance and duration of outdoor recreation (Baker et al., 2023), and reduced access to gyms and leisure centres may have affected eating behaviour and physical

activity levels. Therefore, the thesis also points to a need for further understanding about support for people with obesity during times of disruption, such as the COVID-19 pandemic.

The second intervention study (Chapter 7) also raised questions regarding the specification of goal outcomes. Anecdotally, it is noted that participants within the intervention studies reported that concerns about illness and health outcomes associated with the pandemic motivated their desire to enrol in the study. For some participants, their outcomes of interest were related to *maintenance* of existing behaviours. Whilst this would not have demonstrated change to their physiological outcomes such as adiposity, this represented a meaningful and important change to their weight-related behaviours for participants individually. This may be particularly relevant during times of disruption, when the usual support and interventions cannot be delivered.

7. Study adaptations

Due to the COVID-19 pandemic, several adaptations were made to the studies. Recruitment was impacted in the studies reported in Chapters 5 and 7. Chapter 5 was recruiting during the initial lockdown period in the UK. This meant that the general public were advised to limit their social contact. The first COVID-19 lockdown resulted in the closure of public spaces including educational settings such as the University. As a result, a smaller than expected number of participants were recruited to the study, as it was no longer possible to complete the sessions in-person on the University campus. Therefore, there was not an adequate sample size to complete the statistical analyses. However, it was possible to conduct the content analysis as planned regarding the application of MI-specific and behaviour change techniques within the sessions. Whilst no adaptations were made to this study due to the fluid nature of the initial national lockdown, it informed options available for the design of the next study reported in Chapter 7.

The second study that was impacted by the pandemic is reported in Chapter 7. This study was designed in order to accommodate completely remote recruitment and delivery of the MI sessions through an online video-meeting software (Zoom). This was generally an effective method of hosting the MI session, although some connection issues were occasionally experienced due to issues such as

poor internet connection. The study was designed to collect data through audio recordings of the meeting and the use of an online questionnaire hosting website to facilitate data collection. There were several difficulties associated with collection of data remotely rather than through completion of forms in-person. Firstly, some participants experienced difficulties with completing the form, for example, if they did not complete the click button to confirm their questionnaire was complete, the Qualtrics system did not send a notification that the questionnaire had been submitted. As the form was completed remotely, if they experienced any difficulties during this task there was no synchronous support available, which may have been an option to resolve any issues in-person. Furthermore, difficulties could be experienced during the session itself, such as their device running out of battery or issues with the wireless internet connection for either the participant or myself. There were also impacts to the scheduling of sessions that were directly associated with the impact of COVID-19. Participants experienced changes to their circumstances, for example, their work role changed, they had other caring responsibilities such as childcare during periods of school closures, and some participants fell ill with COVID-19 and were unable to attend the session. Additionally, the topics that were discussed may also have been influenced by the pandemic; participants may have lost or had their access to usual support or facilities limited by closures and social distancing requirements that were in place during the study period.

Due to the difficulties with recruiting and retaining participants, there was not a sufficient sample size to complete the planned statistical analyses. This meant that formal statistical significance testing could not be conducted, limiting the evaluation of effectiveness of the intervention in comparison to the control group. Whilst the data collection method was adapted to use online, remote tools rather than in-person collection, this was not successful. Alternative approaches could consider completing the questionnaires in a more synchronous format, for example, at the end of the online meeting, in order for the researcher to be on hand to answer any queries or problem solve any issues with the form. Alternatively, a researcher could collect their answers over the telephone at a different point, which would remove the potential for errors in submitting or accessing the form.

8. Outstanding issues and future directions

There are several important issues that remain outstanding following the completion of the empirical research. Firstly, the efficacy of techniques should be examined within a longer, larger trial context. The second intervention study reported in this thesis (Chapter 7) was a pilot feasibility assessment of the methods and implementation of MI. Further research will confirm the intervention is acceptable and effective by including a larger sample of patients using quantitative analysis methods. Furthermore, use of multiple interventionists to deliver the MI sessions will provide more knowledge regarding the inter-rater reliability of this approach when delivered in practice. Additionally, understanding of what combination or set of techniques can be implemented for successful behaviour change could be more closely examined within research.

A second outstanding issue is the efficacy of in-person versus remote delivery of interventions to support behaviour change. Whilst the remote delivery of sessions in the current thesis was influenced by the COVID-19 pandemic, use of web-assisted software and telephone delivery can encourage participation and engagement opportunities by removing some barriers (such as distance, travel time, and geographic location). A recent meta-analysis following the increase in-teletherapy use identified no significant difference in outcomes (Lin et al., 2022); further research should examine if the delivery of content remotely is comparable to in-person for behaviour change support.

In terms of the opportunities for implementation, MI may be of particular benefit to pre- or post-bariatric surgery support. Significant and beneficial weight-loss through non-surgical methods such as diet and physical activity intervention is frequently unattainable for some individuals with severe obesity. Behavioural interventions are commonly implemented to support before and after surgery (Stewart & Avenell, 2016). Patients preparing for or recovering from bariatric surgery may require additional support with amending their weight-related behaviours due to the impacts of surgical outcomes on their dietary intake. MI may be one such suitable intervention due to the individualised approach of goal development, action planning and monitoring. This specific application of the approach could be tested further.

9. Concluding remarks

This thesis used an empirical, multi-methods approach to investigate the theoretical mechanisms underpinning Motivational Interviewing (MI) within the context of behaviour change in obesity. To provide new understanding of what the components of this complex intervention entailed, the studies utilised behavioural science tools including the taxonomy of Behaviour Change Techniques (BCTTv1; (Michie et al., 2013)) and specific techniques identified for MI.

The systematic review and meta-analysis reported in Chapter 3 identified limited evidence for the effectiveness of MI. It was not associated with physiological changes (i.e., changes to bodyweight and BMI) above and beyond that of comparator conditions. However, findings suggested promise for effects on weight-related behavioural outcomes including physical activity and eating behaviour. Due to reductive reporting of intervention content, it was challenging to establish what was being delivered 'in the field' as interventions were typically described as simply, 'a Motivational Interviewing approach.' To understand what was occurring, interventions were coded and a number of techniques were identified as commonly involved within an MI approach, namely u*nspecified social support,* and techniques from the *goals and planning* or feedba*ck and monitoring* categories such as *self-monitoring of behaviour, problem solving, goal setting* and *information about health consequences*. This demonstrated that it was possible to more clearly delineate what mechanisms were present within MI interventions, although the findings were limited by poor reporting of intervention content generally.

The qualitative study reported in Chapter 4 discussed the meaningful components of behaviour change support with practitioners from a range of healthcare settings. Thematic analysis of the interview transcripts showed that healthcare professionals considered the rapport built between themselves and their patients to be an important component of successful behaviour change support. It also demonstrated that professionals considered MI skills to help provide a deeper understanding of the individual patient, which supported the development of individualised action plans for change that were achievable and realistic for their patients.

Chapter 5 reported an empirical study that assessed the implementation of MI within a time-limited intervention to support physical activity behaviour change. Whilst the delivery and data collection were affected by the coronavirus pandemic, behavioural determinant scores increased significantly from baseline to final measurement. This suggested the intervention was effective at supporting participant's perceptions of their capability, opportunity and motivation to engage with behaviour change. Furthermore, a coding study that was nested within the analysis demonstrated that several techniques were frequently present in the audio of the MI sessions: these were *action planning, behaviour goal setting,* and *review of behavioural goals.* From an MI-specific perspective, the key skills of MI (*open-ended questions, affirmations, reflections* and *summary statements;* 'OARS'), were coded frequently alongside *agenda-mapping.* This demonstrates that the rapport-building relational content was present within the sessions. Agenda-mapping suggests that the participants were involved and their autonomy and right to decide what was discussed in sessions was promoted. This study suggested that the mechanisms of MI work to support improvements to these behavioural determinants and it was theorised that increases to capability, opportunity and motivation will result in successful outcomes of the desired behaviour.

The randomised controlled trial feasibility study reported in Chapter 7 randomised participants to receive either three sessions of MI or a comparator condition. However, there were no significant differences identified between the increases to behavioural outcomes between the intervention and comparator condition. However, the nested coding component of this study found that there were several techniques frequently utilised in sessions where participants considered their change to be successful; these techniques were *goal-setting of outcomes, feedback on behaviour,* and *information about antecedents.* This suggests that supporting participants with identifying their desired outcomes of behaviour, supporting reflection and feedback on changes to behaviour, and discussing the 'triggers' of behaviours are effective mechanisms in weight-related behaviour change support.

Taken together, the findings of these study provide some limited support for MI as an intervention for weight-related behaviour change within the context of obesity. Obesity is a

multifactorial health condition influenced by a unique combination of our environment, psychology, social context, biology and genetics (Perriard-Abdoh et al., 2019). Our behaviour, such as the amount or type of food we eat, and physical activity, are modifiable factors that can be used to provide support for individuals looking to make bodyweight-related changes (Dombrowski et al., 2014).

Several conclusions can be drawn from the sequentially designed empirical research reported in the present thesis. Firstly, MI appears to be an effective way of supporting changes to the determinants of behaviour, namely capability, opportunity, and motivation; in particular, improvements are noted to automatic motivation. Secondly, the important mechanisms of this approach appear to be related to the development of plans and goals for the behaviour and outcome of behaviour, in addition to the use of relational techniques to build rapport. Thirdly, MI was effective at supporting changes to behavioural determinants, even during disruption to wider environmental and social factors associated with the pandemic. Finally, from the perspective of healthcare professionals, MI skills were considered to be beneficial when implemented within several different healthcare contexts as they supported engagement with patients and provided structure for the conversations to follow.

However, there are several important caveats: firstly, systematic review and meta-analysis of previous research demonstrates no association with physiological outcomes. Therefore, research which uses BMI or bodyweight as an outcome is unlikely to provide support for the approach without introducing longer-term follow-up periods that will allow the impacts of increased capability, opportunity and motivation determinants to be measured. Secondly, the studies reported in the current thesis were underpowered, although the findings suggest that the research design was appropriate for future studies of effectiveness. Finally, MI was implemented within sessions designed to support a range of different weight-related behavioural goals whilst maintaining fidelity to the approach. MI is a complex approach and training and fidelity of practitioner skills should be routinely assessed and reported within research studies. Carefully designed research studies including these elements will lead to the development of effective interventions which acknowledge the individual experience of weight-related behaviour change in obesity.

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Appendices

Appendix a. Chapter 4 Ethical approval letter

UNIVERSITY OF LIVERPOOL

Health and Life Sciences Research Ethics Committee (Psychology, Health and Society)

14 June 2018

Dear Dr Fallon

I am pleased to inform you that your application for research ethics approval has been approved. Application details and conditions of approval can be found below. Appendix A contains a list of documents approved by the Committee.

Application Details

Reference:	3479
Project Title:	Researching practitioner experiences of Motivational Interviewing (MI) in healthcare
Principal Investigator/Supervisor:	Dr Vicky Fallon
Co-Investigator(s):	Miss Harriet Makin, Dr Laura Goodwin
Lead Student Investigator:	-
Department:	School of Psychology
Approval Date:	14/06/2018
Approval Expiry Date:	Five years from the approval date listed above

The application was **APPROVED** subject to the following conditions:

Conditions of approval

- All serious adverse events must be reported via the Research Integrity and Ethics Team (ethics@liverpool.ac.uk) within 24 hours of their occurrence.
- If you wish to extend the duration of the study beyond the research ethics approval expiry date listed above, a new application should be submitted.
- If you wish to make an amendment to the research, please create and submit an amendment form using the research ethics system.
- If the named Principal Investigator or Supervisor leaves the employment of the University during the course of this approval, the approval will lapse. Therefore it will be necessary to create and submit an amendment form using the research ethics system.
- It is the responsibility of the Principal Investigator/Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

Health and Life Sciences Research Ethics Committee (Psychology, Health and Society)

iphsrec@liverpool.ac.uk

0151 795 5420

Appendix - Approved Documents

(Relevant only to amendments involving changes to the study documentation)

The final document set reviewed and approved by the committee is listed below:

Document Type	File Name	Date	Version
Interview Schedule	Topic guide for MI users V4	14/05/2018	4
Interview Schedule	Topic guide for MI non-users V4	14/05/2018	4
Participant Information Sheet	Participant Information Sheet V4	14/05/2018	4
Participant Consent Form	Consent form V3	14/05/2018	3
Research Tools	Debrief V1	14/05/2018	1
Research Tools	Eligibility screen V2	14/05/2018	2
Advertisement	Recruitment flyer May 2018 V2	15/05/2018	2
Participant Information Sheet	Participant Information Sheet V5	13/06/2018	V5

1

1 Appendix b. Chapter 4 Completed risk assessments for interviews

Version 2 May 2018

UNIVERSITY OF LIVERPOOL

RISK ASSESSMENT FORM

School/Department: School of Psychology	**Building: Eleanor Rathbone Building**
Task: Research interviews with healthcare practitioners about their use of specific communication skills (Motivational Interviewing). Interviews may be face-to-face on the University of Liverpool campus, or off-campus in public locations in the UK. Interviews may be conducted remotely via telephone or Skype. Interviews will be recorded and transcribed by the researcher.	
Persons who can be adversely affected by the activity: Participants, researcher	

Section 1: Is there potential for one or more of the issues below to lead to injury/ill health (tick relevant boxes)

People and animals/Behaviour hazards

Allergies		"Too few people		Horseplay		Repetitive action		Farm animals	
Disabilities		"Too many people		Violence/aggression		Standing for long periods		Small animals	
Poor planning		Non-employees		Stress		Fatigue		Physical size, strength, shape	
Poor supervision		Drunk/Disorder		Pregnancy/expectant mothers		Awkward body postures		Potential for human error	
Lack of experience		Lack of assurance		Static body postures		Lack of or poor communication		Taking short cuts	
Children		Rushing		Lack of mental ability		Language difficulties		Vulnerable adult group	

What controls measures are in place or need to be introduced to address the issues identified?

Identified hazards	CURRENT CONTROLS	RISK SCORE	ADDITIONAL CONTROLS REQUIRED (To include responsibilities and timescales)	RESIDUAL RISK SCORE

2

Version 2 May 2018

Section 2: Common Workplace hazards. Is there potential for one or more of the issues below to lead to injury/ill health (tick relevant boxes)

Fall from height		Poor lighting		Portable tools		Fire hazards		Chemicals		Asbestos	
Falling objects		Poor heating or ventilation		Powered/moving machinery		Vehicles		Biological agents		Explosives	
Slips, trips, falls		Poor space design		Lifting equipment		Radiation sources		Waste materials		Genetic modification work	
Manual handling		Poor welfare facilities		Pressure vessels		Lasers		Nanotechnology		Magnetic devices	
Display screen equipment	X	Electrical equipment		Noise or vibration		Confined spaces		Gases		Extraction systems	
Temperature extremes		Sharps		Drones		Cytogenitic		Legionella		Robotics	
Home working		Poor signage		Overseas work		Overnight experiments		Unusual events		Community visits	X

1

Version 2 May 2018

Late/lone working		Lack of/poor selection of PPE		Night work		Long hours		Weather extremes		Diving	

What controls measures are in place or need to be introduced to address the issues identified?

Identified hazards	CURRENT CONTROLS	RISK SCORE	ADDITIONAL CONTROLS REQUIRED (To include responsibilities and timescales)	RESIDUAL RISK SCORE
Display screen equipment	For researcher use, the University computer has been assessed and DSE form completed. Telephone is a University office landline. Equipment has been PAT tested. Participants will complete Skype/telephone interviews off-site using their own equipment.	1		
Community visits	Researcher will be aware of local health and safety information and will know their nearest emergency exit in all locations. In case of emergency situations the supervisors will be contacted immediately. Face-to-face interviews will be scheduled during the working week (Monday - Friday) and between normal working hours (9am - 5pm). As such, when the interviews take place at a University site, support from Facilities Management staff (building manager and security) will be available in addition to the supervisor and other University staff within the building. Off-campus interviews will be in public locations	2		

Version 2 May 2018

	where the researcher will be aware of all relevant local health and safety information and nearest fire exits. A member of University staff not attending the face-to-face interview will be informed of the location and anticipated timing of the interview and will be contacted to confirm completion. A mobile phone will always be carried by the researcher conducting the interview. The supervisors will have this telephone number if contact is required			

1

Version 2 May 2018

Section 4: Emergency arrangements (List any additional controls that are required to deal with the potential emergency situation)

Emergency situation	Additional control required

Risk assessor (signature).....Date..... Authorised by (signature).....Date 16 5 18

V1
May 2018

UNIVERSITY OF LIVERPOOL

RISK ASSESSMENT – COMMUNITY VISITING

This form should be completed for community visiting and survey work. The University's Code of Practice for Safety in Fieldwork requires that for such work an itinerary must be left with a responsible person and other precautions taken as judged appropriate in a risk assessment.

DEPARTMENT
School of Psychology

SUPERVISOR(S)
Dr Vicky Fallon
Dr Laura Goodwin

BRIEF DESCRIPTION OF PROJECT

Research interviews with healthcare practitioners about their use of specific communication skills (Motivational Interviewing). Interviews may be face-to-face on the University of Liverpool campus, or off-campus in public locations (e.g. café, library) in the UK during normal working hours (9am-5.30pm). Interviews may be conducted remotely via telephone or Skype. Interviews will be recorded and transcribed by the researcher.

For student courses state the number of students:

N/A

For projects involving individuals or small numbers give the names and staff/student numbers of those carrying out the fieldwork:

Harriet Makin 200939830

V1
May 2018

HAZARD/RISK ANALYSIS

Is there any risk to personal safety? **Yes/No**

Comments on the risk:

Researcher will be aware of local health and safety information and will know their nearest emergency exit in all locations. In case of emergency situations the supervisors will be contacted immediately.

Face-to face interviews will be scheduled during the working week (Monday - Friday) and between normal working hours (9am – 5.30pm). Off-campus interviews will be in public locations where the researcher will be aware of all relevant local health and safety information and nearest fire exits. Only well-lit public locations will be selected as interview site.

A member of University staff not attending the face-to-face interview will be informed of the location and anticipated timing of the interview and will be contacted to confirm completion. A mobile phone will always be carried by the researcher conducting the interview. The supervisors will have this telephone number if contact is required.

Will visits take place during hours of darkness? **Yes/No**
If so, are extra precautions required?

N/A

V1
May 2018

PRECAUTIONS
What arrangements are in place for leaving an itinerary of movements and expected return times with a responsible person?

Supervisor not attending the interview will be informed of the location, start time and anticipated end time. The researcher will contact them to confirm completion of the interview. A mobile phone will be carried by the researcher at all times when conducting the interview. The supervisors will contact the researcher via phone if no contact is made after the anticipated end time.

Are the following precautions appropriate?

	YES	NO	N/A	Notes
Pre-visit checks, e.g. on records	X			Records of location, interviewee contact details, timings given to supervisor before interview
Visiting in pairs with a companion in earshot		X		Interviews are being carried out by a single PhD student
Personal alarms	X			Researcher can carry a personal alarm
Mobile phones	X			Researcher will carry a mobile phone
Regular reporting to base and follow-up procedure	X			Researcher will always report regularly to the supervisors and supervisors will contact if contact is not made when expected
Training in interpersonal communication skills	X			Researcher trained in interpersonal communication skills
Parking in appropriate well lit areas			X	Not driving
Security locks on vehicles			X	Not driving
Anti-theft devices and alarms			X	Not driving
Other precautions (state)			X	N/A

WORK MAY PROCEED SUBJECT TO THE CONDITIONS STATED IN THIS ASSESSMENT

Signed ..... **Status** DSC **Date** 16.5.18

1

2

3

4

Appendix c. Chapter 4 Participant information sheet and consent form

Participant Information Sheet

A qualitative investigation of practitioner experiences and attitudes towards Motivational Interviewing (MI) in healthcare settings.

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and feel free to ask questions if you would like any further information or if there is anything which you do not understand. Please also feel free to discuss this with your friends and relatives. You do not have to participate in this study, and you should only take part if you want to. The data collected from this research will be used for a PhD research study and the findings will be written up for publication in academic journals.

Please read this information thoroughly before you decide if you would like to participate.

1. What is the purpose of the study?

The aim of this research study is to investigate experiences of and attitudes towards a counselling approach called Motivational Interviewing (MI). This research study aims to discover what experiences healthcare staff and others have of Motivational Interviewing training, what they understand the approach to be, and how this may be translated into professional practice. This is intended to provide a richer understanding of how MI is used in practice by helping us to understand what individuals believe MI is and how it works to produce sustained changes in health-related behaviours. Previous research has looked at how useful people view training in Motivational Interviewing to be and suggests that people may have different understandings of what Motivational Interviewing actually is.

2. Why have I been chosen to take part?

You are being invited to take part in this research study because you are employed in a healthcare setting (or are no longer employed, but have left your role within the last 5 years), you are over the age of 18 years, you are fluent in English, and you have received some training in Motivational Interviewing. You may have received training and chosen to use Motivational Interviewing currently or in the past. You may have received training and chose not to use Motivational Interviewing in your professional role. We are also

inviting non-practitioners who have received education in Motivational Interviewing to take part. This is to provide a range of perspectives, including from individuals who do not use these skills in a practice setting, about what Motivational Interviewing involves. This research study is interested in your own personal experiences of Motivational Interviewing, and not those of any clients or patients that you have come into contact with through your professional role. This means that we would like to know more about how you have learned about Motivational Interviewing, and what techniques and skills you understand Motivational Interviewing to involve. It is not necessary to discuss any experiences that you have had with clients or patients, such as specific consultations.

3. Do I have to take part?

You are not required to take part in this research study if you do not wish to. Your participation in this study is completely voluntary. Participants are free to withdraw from the study at any time until the data has been anonymised, without the need to give explanation. You will not be able to withdraw the data that you have provided after anonymization as your data will not be identifiable as yours. It is anticipated that your data will be anonymised within two weeks after the interview is complete.

4. What will happen if I take part?

The consent process

Before you take part, you will have the opportunity to ask any questions that you would like to about the study. If you decide to take part, the researcher will provide you with a copy of the screening eligibility form. If you indicate that you would like to take part in a telephone or Skype interview, a consent form will be emailed to you or posted to the contact address provided with a return envelope. For face-to-face interviews, consent will be taken at the start of the interview session.

The interview

The interviews are semi-structured and will be led by a researcher from the University of Liverpool after you have consented to participate in the study. You will only need to have one interview session with the researcher. The interview involves being asked about and given the opportunity to discuss perceptions, opinions, beliefs and attitudes towards topics around Motivational Interviewing. We are interested to hear about your experiences of learning about Motivational Interviewing, and the way that you use it in practice. We are interested in your personal experiences, rather than those of clients or patients that you may work

with in your professional capacity. There are no right or wrong answers and you will not be judged in any way based on the responses you provide. The interview can take place in a public place that is convenient for you, or at the University of Liverpool in the Department of Psychological Sciences. The interview can also take place using Skype or telephone. It is anticipated that these interviews will last around 1 to 2 hours with allowances for breaks at any time.

After the interview

These interviews will be recorded using a Dictaphone and transferred to a University computer, before being transcribed by the researcher – we will ask for your consent before doing this. You will be able to review your interview transcript before it is included for analysis if you would like to do this. Please see **Q9** for information on how your data will be stored, archived and used. The interview transcripts collected will be transcribed and analysed using thematic and framework analysis approaches.

5. Expenses and/or payments

Participants will receive a £10 voucher on completion as a reimbursement for the time spent taking part in the study. Reasonable reimbursement for travel expenses will also be provided upon receipt.

6. Are there any risks in taking part?

We do not foresee that there will be any risks associated with taking part in this research study. Predicted adverse effects are minimal and it is very unlikely that this study will lead to any physical or psychological adverse effects, risks or hazards. If for any reason you do find any elements of the interview distressing or you would like to withdraw, please tell the researcher immediately and the interview will be stopped.

7. Are there any benefits in taking part?

There are no direct benefits to taking part in this research study. However, you may find it interesting to discuss your use or non-use, and understanding of of Motivational Interviewing. The data that you provide will help us to understand how Motivational Interviewing is applied in practice. With this insight, it may contribute towards developments in the training and use of Motivational Interviewing to produce effective behaviour change in healthcare settings.

8. What if I am unhappy, or if there is a problem?

If you are unhappy, or if there is a problem, please let us know by contacting the principal investigator, Dr Vicky Fallon (0151 794 1402; v.fallon@liverpool.ac.uk), who will try to help. If you remain unhappy, or have a complaint which you do not feel you can come to the researchers with, you can contact the Research Governance Officer at ethics@liverpool.ac.uk. When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

9. Will my participation be kept confidential?

Your participation will be kept entirely confidential. To ensure confidentiality of your personal data, you will also be provided with a participant number which will appear on the interview transcripts. During the transcription process, pseudonyms will be used to replace the names of all family, friends, colleagues, and places that you may mention during the interview. Pseudonyms will also be given to accompany any quotes that you provide that are included in publications. You will not be identifiable from any quotes included for publication.

As the data from this study is intended to be used in future publications, audio files will be kept on a secure university computer drive until the researcher has transcribed the interview audio. At this point, the data will be removed from the secure university drive using software applications designed to remove all data. Transcripts generated from these audio files will be retained on the secure University computer drive for a further 10 years. Any participant information stored on computer will be kept in a password protected folder, only accessible to the research team and will be identifiable only by a participant number. Hard copies of any information will be kept securely until the time of publication before being destroyed. Paper records will be shredded and recycled. Records stored on a computer hard drive will be erased using software applications designed to remove all data from the storage device.

10. Disclosure of criminal activity

If you tell the researcher something that may suggest you or another individual may be harmed, confidentiality may not always be assured. In the rare case that disclosures are made surrounding safeguarding, abuse, neglect, substance abuse, or other criminal activities, the principal investigators will be informed in order to carry out university-approved procedures, which may include informing health professionals or the police of relevant information.

11. What will happen to the results of the study?

The results of the study will be used towards a thesis for a PhD in Psychology. We also hope to publish the results of the study in scientific journals and present the findings at academic conferences. Data collected in this study will be made publicly available through the use of a general purpose data repository e.g. Dryad. Any data made publicly available will be anonymised. After the study is completed and ready for publication, the final study report will be made available at your request.

12. What will happen if I want to stop taking part?

You are able to withdraw from the study at any time until after the point of anonymisation of the interview transcripts if you no longer wish to take part in the study. The point of anonymisation is anticipated to be two weeks after the interview is complete. After this point, your data will not be identifiable as yours, and therefore it may not be possible to withdraw the data that you have provided. If you withdraw from participation prior to the point of anonymisation, your data will be destroyed.

13. Who can I contact if I have further questions?

Contact details of researchers involved in the current study are as follows;

Principal Investigator:	Student Investigator:
Dr Vicky Fallon	Miss Harriet Makin
Institute of Health, Psychology and Society Eleanor Rathbone Building University of Liverpool L69 7ZA	Institute of Health, Psychology and Society Eleanor Rathbone Building University of Liverpool L69 7ZA
0151 794 1402	0151 795 7511
v.fallon@liverpool.ac.uk	h.e.makin@liverpool.ac.uk

UNIVERSITY OF LIVERPOOL

Participant code:

Committee on Research Ethics

PARTICIPANT CONSENT FORM

Title of the research project: A qualitative investigation of practitioner experiences and attitudes towards Motivational Interviewing (MI) in healthcare settings.

Researcher(s): Miss Harriet Makin, Dr Vicky Fallon, & Dr Laura Goodwin

Please initial box

1. I confirm that I have read and have understood the information sheet dated [**May 2018**] for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason until after my interview transcripts have been anonymised, without my rights being affected. In addition, should I not wish to answer any particular question or questions, I am free to decline. ☐
3. I understand that, under the Data Protection Act 1998, I can at any time prior to the point of anonymization ask for access to the information I provide and I can also request the destruction of that information if I wish. I understand that it may not be possible to identify and destroy this information after the point of anonymization. ☐
4. I agree for the data I provide to be archived at the University of Liverpool. I understand that other authorised researchers will have access to this data after anonymisation. ☐
5. I understand that the anonymised data I provide may be used for publication in an academic journal. ☐
6. I agree to take part in the above study. ☐

	Yes	No
7. Would you like to receive a copy of the research findings upon completion?	☐	☐
8. Do you consent to an anonymised version of your data being used in future research?	☐	☐

Please sign on the next page

UNIVERSITY OF LIVERPOOL

Participant code:

Participant name	Date	Signature
Researcher	Date	Signature

Principal Investigator

Dr Vicky Fallon

Institute of Health, Psychology and Society
Eleanor Rathbone Building
University of Liverpool L69 7ZA

0151 794 1402

v.fallon@liverpool.ac.uk

Student Investigator

Miss Harriet Makin

Institute of Health, Psychology and Society
Eleanor Rathbone Building
University of Liverpool L69 7ZA

0151 795 7511

h.e.makin@liverpool.ac.uk

Appendix d. Chapter 4 Participant recruitment poster

V3.0
Recruitment poster end date
University of Liverpool Research Ethics Committe

UNIVERSITY OF LIVERPOOL

We are looking for health professionals to speak to us about communication

We are conducting research with health professionals regarding **communication approaches with patient populations,** and any experiences they may have had with an approach called **Motivational Interviewing.**

Inclusion criteria:

- 18+ years, fluent English speaker
- You are currently, or have recently been, employed in any kind of healthcare context
- You have taken part in **any kind** of Motivational Interviewing training in the past, and you **do not use it in your practice**.

What will happen if I choose to participate?

- You will meet with a researcher to discuss your attitudes, training experiences and understanding of MI and its components.
- This could be in person, or via Skype/telephone.

Please contact **Harriet Makin** for more information about the *MI and practitioners* study:

H.E.Makin@liverpool.ac.uk
(0151) 795 7511

Appendix e. Chapter 4 Interview topic guides

Interview Guide

Exploring practitioner experiences of Motivational Interviewing – User of MI

Thank you for agreeing to speak with me about your experiences of Motivational Interviewing. There are a couple of different topics that I would like to hear your views about, including your experiences of being trained in Motivational Interviewing, what you feel it involves to deliver Motivational Interviewing with a client, and how you think some of its techniques work. I am interested in your perspective here and there are no right or wrong answers. I would like to hear about what it has been like for you personally. With your permission I would like to record the interviews. After our session, I will transcribe the audio and then delete the recording. I will make sure to anonymise all of your information, so that you won't be identifiable from the transcription. I can arrange for you to review the transcription before it is analysed, if you would like me to do so. Should you wish to stop the interview at any time or take a break, please let me know.

Section A – Demographics and basic info

I would like to ask you some brief factual questions first, and then we will start discussing Motivational Interviewing and your experiences. The information I am about to ask from you will be anonymised, and you won't be identifiable from the transcripts.

1. Please could you tell me your surname, and whereabouts you are currently based?
2. Where were you born? When were you born?
3. Can you tell me what your professional role is?
4. Do you use Motivational Interviewing in practice? (If YES sections B C1 D E. If NO sections B C2 D2 E).

Section B – Motivational Interviewing training experiences

I would like to ask you about your experiences of learning about Motivational Interviewing next.

1. When did you first hear about Motivational Interviewing?
2. How long was the time period between first hearing about it and receiving training?
3. When did you receive this training? How did you find/identify the training course?
4. How long was the training course in duration?
5. Can you tell me what the set up of the training course was like?
    - Prompts: Number in group, trainer details, format of exercises, opportunities to practice
6. Have you received any more training since this date?
7. (If yes Q6) Can you tell me a little about this?
8. How useful have your training experiences of MI been for you?
9. Have you participated in any self-study about Motivational Interviewing?
    - Prompts: Reading books or articles about MI, BMJ module about MI, practicing MI with friends/family/colleagues/etc
10. How difficult do you think it was to learn about Motivational Interviewing?
    - Prompts: learning a new style or something you got the hang of quickly
11. How confident do you feel in your Motivational Interviewing practice today?
12. Would you like to learn more about Motivational Interviewing?
    -

Section C1: Motivational Interviewing in practice experiences <u>FOR USERS OF MI if non-user, go to C2</u>

I am going to ask you some questions about your experience of using Motivational Interviewing in practice. I would like to remind you that I am interested in hearing about your personal experiences, and <u>not</u> those of any patients or clients that you may have worked with.

1. How frequently do you think that you use Motivational Interviewing in your professional role?
    - Prompts: With every person that comes to see you/only every so often
2. What are your reasons for using Motivational Interviewing in your work?
    - Prompts: recommended by your team, think it works/doesn't work, trained in applying it

1. (If not all the time to Q1) What kind of decisions do you think you need to make to decide to use or not use Motivational Interviewing?
    - Prompts: Specific client needs/what kind of challenges in the conversation
2. Please could you outline a general format of the conversation when you are using Motivational Interviewing?
    - Prompts: stages of MI - engaging, evoking, eliciting, summarising
3. Can you think of anything that makes it easier or harder to use Motivational Interviewing in practice? Can you tell me a little bit about that?
4. Are there any aspects of Motivational Interviewing that you dislike or choose not to use? If so, how do you make these decisions?
5. Are there specific contexts where you choose to use or not use Motivational Interviewing?
    - Prompts: Are there situations where you make a conscious choice to use it? N.b. remind not specific client experiences
6. Do you think that you use Motivational Interviewing exactly as you were taught to in your training, or do you think that you make changes to your practice?
7. Do you ever receive any kind of supervision of your Motivational Interviewing?
8. Do you make your patients or clients aware that you are using Motivational Interviewing techniques? If so, how do you do this?
    - Prompts: is it integrated into your daily practice, or do you pick when to apply it
9. (If yes Q5) What do you think your patients or clients think about Motivational Interviewing?

Section C2 – Reasons for non-use of Motivational Interviewing <u>FOR NON-USERS OF MI</u>

Section D1 – Motivational Interviewing beliefs FOR USERS OF MI – if non-user, go to D2

1. Please could you explain to me what you would define Motivational Interviewing as to somebody who doesn't work in the same setting as you?
    - Prompts: how would you explain Motivational Interviewing to somebody who didn't work in healthcare?
2. Could you give me a technical definition that you might give to a colleague?
3. Have you heard of the 'spirit' of MI? Please could you explain what you perceive the spirit of MI to be?
4. Have you heard of behaviour change techniques, which are used to help people change their health-related behaviours? (If no: behaviour change techniques are the actions that you may recommend to patients to change their health behaviours. For example, you may suggest to somebody who is trying to quit smoking that they keep a record of how many cigarettes they have a day.)
5. Please could you describe some of the techniques that you may use in your professional setting to help people change their behaviours? (n.b. confirm if used with/without MI)
6. How do you think that you use these techniques when you are using Motivational Interviewing?
7. Do you think that Motivational Interviewing helps you/your clients to make progress? If so, please can you explain in what ways you think it helps to make progress?

Section D2 – Motivational Interviewing beliefs FOR NON-USERS OF MI

Section E – closing the interview/confidentiality/interest/debrief

1. Would you like to talk about anything else before we finish the interview?
2. Is there anything that I forgot to ask, or things that you think I should be asking about to help me to understand your experiences of Motivational Interviewing?
3. How do you think I should be asking these questions?

"Thank you for agreeing to participate in this research study. If you would like to speak with me or the Principal investigator regarding the study, my contact details are available on the debrief sheet (if face-to-face interview, give debrief and point out section with contacts. If Skype/telephone, confirm email follow-up with debrief form). Please feel free to pass them on to anybody else that you think may be interested. This research study may be published in an academic journal. Please remember that you are able to withdraw from the study at any time until the anonymization of your data. This is because you will not be identifiable after this point. If you would like to review your interview transcript before it is included for analysis, please let me know, and we will arrange for you to receive a copy."

Exploring practitioner experiences of Motivational Interviewing – Non-user of MI

Thank you for agreeing to speak with me about your experiences of Motivational Interviewing. There are a couple of different topics that I would like to hear your views about, including your experiences of being trained in Motivational Interviewing, any experiences you may have had of using Motivational Interviewing, and your opinions about. I am interested in your perspective here and there are no right or wrong answers. I would like to hear about what it has been like for you personally. With your permission I would like to record the interviews. After our session, I will transcribe the audio and then delete the recording. I will make sure to anonymise all of your information, so that you won't be identifiable from the transcription. I can arrange for you to review the transcription before it is analysed, if you would like me to do so. Should you wish to stop the interview at any time or take a break, please let me know.

Section A – Demographics and basic info

I would like to ask you some brief factual questions first, and then we will start discussing Motivational Interviewing and your experiences. The information I am about to ask from you will be anonymised, and you won't be identifiable from the transcripts.

5. Please could you tell me your surname, and whereabouts you are currently based?

6. Where were you born? When were you born?

7. Can you tell me what your professional role is?

8. Do you use Motivational Interviewing in practice?

Section B – Motivational Interviewing training experiences

I would like to ask you about your factual experiences of learning about Motivational Interviewing next.

13. When did you first hear about Motivational Interviewing?

14. How long was the time period between first hearing about it and receiving training?

15. When did you receive this training? How did you find/identify the training course?

16. How long was the training course in duration?

17. Can you tell me what the set up of the training course was like?

1. *Prompts: Number in group, trainer details, format of exercises, opportunities to practice*

18. Have you received any more training since this date?

19. (*If yes* Q6) Can you tell me a little about this?

20. How useful have your training experiences of MI been for you?

21. Have you participated in any self-study about Motivational Interviewing?

2. *Prompts: Reading books or articles about MI, BMJ module about MI, practicing MI with friends/family/colleagues/etc*

22. How difficult do you think it was to learn about Motivational Interviewing?

3. *Prompts: learning a new style or something you got the hang of quickly*

23. Would you like to learn more about Motivational Interviewing?

Section C2: Motivational Interviewing in practice beliefs

I am going to ask you some questions about what you think it would be like to use Motivational Interviewing in practice. I would like to remind you that I am interested in hearing about your personal experiences, and ***not*** *those of any patients or clients that you may have worked with.*

1. Have you ever used Motivational Interviewing in practice previously?

4. *Prompts: In the past, opted to not use it or have stopped using it*

2. What is your understanding of a traditional format of a Motivational Interviewing session? Please could you describe the steps involved to me?

3. What are your reasons for not using Motivational Interviewing in practice currently?

4. What kind of decisions did you need to make to decide not to use Motivational Interviewing?

5. What do you think a patient or client would think about Motivational Interviewing?

Section D2 – Motivational Interviewing beliefs

1. Please could you explain to me what you would define Motivational Interviewing as to somebody who did not work in the same setting as you?

5. *Prompts: how would you explain Motivational Interviewing to a friend or family member?*

2. Could you give me a technical definition that you might give to a colleague?

3. How do you think your understanding of MI might differ to somebody else?

4. Have you heard of the 'spirit' of MI? Please could you explain your understanding of this to me?

5. Have you heard of behaviour change techniques, which are used to help people change their health-related behaviours? (***If no: behaviour change techniques are the actions that you may recommend to patients to change their health behaviours. For example, you may suggest to somebody who is trying to quit smoking that they keep a record of how many cigarettes they have a day.)***

6. Please could you describe some of the techniques that you may use in your professional setting to help people change their behaviours? (***n.b. confirm if used with/without MI)***

7. What techniques do you think other people try to use in Motivational Interviewing?

Section E – closing the interview/confidentiality/interest/debrief

4. Would you like to talk about anything else before we finish the interview?

5. Is there anything that I forgot to ask, or things that you think I should be asking about to help me to understand your experiences of Motivational Interviewing?

6. How do you think I should be asking these questions?

"Thank you for agreeing to participate in this research study. If you would like to speak with me or the Principal investigator regarding the study, my contact details are available on the debrief sheet **(if face-to-face interview, give debrief and point out section with contacts. If Skype/telephone, confirm email follow-up with debrief form).** *Please feel free to pass them on to anybody else that you think may be interested. This research study may be published in an academic journal. Please remember that you are able to withdraw from the study at any time until the anonymization of your data. This is because you will not be identifiable after this point. If you would like to review your interview transcript before it is included for analysis, please let me know, and we will arrange for you to receive a copy."*

Appendix f. Chapter 4 Participant debrief form

Participant debrief sheet
Version 1.0 ǁ May 2018

UNIVERSITY OF LIVERPOOL

Title of the research project: A qualitative investigation of practitioner experiences and attitudes towards Motivational Interviewing (MI) in healthcare settings.

Thank you for participating in this study.

What was the study about?

The aim of this research study is to investigate the experiences and attitudes of people working in healthcare settings towards a counselling approach called Motivational Interviewing (MI). This is intended to provide a richer understanding of how MI is used in practice by helping us to understand what practitioners believe MI is and how it works to produce sustained changes in health-related behaviours. Previous research has looked at how useful people view training in Motivational Interviewing to be. However, there is also research which argues that many people have different understandings of what Motivational Interviewing is. This research study aimed to discover what experiences healthcare staff have of Motivational Interviewing training, what they understand the approach to be, and how they translate this into their professional practice. The interview recordings will be transcribed by the researcher, and then analysed using thematic and framework analysis approaches.

What if I want more information about Motivational Interviewing?

If you would like information about Motivational Interviewing, you may find the following organisation helpful:

Motivational Interviewing Network of Trainers (MINT) - http://www.motivationalinterviewing.org/

Who can I contact if I have further questions?

You can contact the Principal Investigator or the Student Investigator using the details at the end of this form. If you have a problem, you can also contact the Research Governance Officer at ethics@liverpool.ac.uk. When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the query that you wish to make.

Principal Investigator

Dr Vicky Fallon

Institute of Health, Psychology and Society
Eleanor Rathbone Building
University of Liverpool L69 7ZA

0151 794 1402

v.fallon@liverpool.ac.uk

Student Investigator

Miss Harriet Makin

Institute of Health, Psychology and Society
Eleanor Rathbone Building
University of Liverpool L69 7ZA

0151 795 7511

h.e.makin@liverpool.ac.uk

1 Appendix g. Chapter 4 Reporting for qualitative studies (COREQ) checklist

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

YOU MUST PROVIDE A RESPONSE FOR ALL ITEMS. ENTER N/A IF NOT APPLICABLE

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the inter view or focus group?	Results
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	Methods
3. Occupation	What was their occupation at the time of the study?	Methods
4. Gender	Was the researcher male or female?	N/A
5. Experience and training	What experience or training did the researcher have?	Methods
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	N/A
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	N/A
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Methods
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Methods
Participant selection		

10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Methods
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods
12. Sample size	How many participants were in the study?	Results
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Methods
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Methods
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	Results
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Results
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods
20. Field notes	Were field notes made during and/or after the inter view or focus group?	Methods
21. Duration	What was the duration of the inter views or focus group?	Methods
22. Data saturation	Was data saturation discussed?	Methods
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Methods
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	Methods
27. Software	What software, if applicable, was used to manage the data?	NVivo

28. Participant checking	Did participants provide feedback on the findings?	Strengths and limitations
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Relationship to existing knowledge
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Discussion

Appendix h. Chapter 4 Transcript excerpts

Theme 1: The purpose & utility of core components of MI

"…a way of talking to people about change, and exploring ambivalence about change, that is patient centred and also is directive as well…you're not just listening to the patient, you're also guiding them towards change." (PPTID_01).

"I think that you get to develop a better rapport with your patients. I think that you get to really listen to their story, and what's going on for them. And also, it's very rewarding to hear the patient want to change for themselves and not because you're telling them to. "(PPTID_01).

"It's a different approach because with MI you're not really telling someone to change, you're just trying to support them to make that change themselves." (PPID_01).

"…we talk about the skills that we're using. So as well as the work that I do, it very much has become a departmental approach…" (PPTID_02).

"The way that we, as practitioners, are. The way we think, the way we behave, and the way that we view the people that we work with. And so if we approach conversations with an empathic, non-judgemental, accepting way, if we work together with people, if we have compassion for them, and if we're there to help draw out their motivations…" (PPTID_02).

"It's been the biggest shift for me in my practice that I've moved away from a very dictatorial, judgemental, non-accepting style…previously I might have had a dialogue in my mind of why can't you change this, and I get frustrated…" (PPTID_02).

"…it's so hard to summarise but we do things like reflections and active listening, obviously avoiding the righting reflex and, so those are the principles that we go by. To be honest with you though, when you're in clinical practice you tend to kind of merge and develop your own kind of style with it so I think it can be quite difficult to draw out the individual components of MI techniques, and just know that generally you are delivering MI. But your reflections are quite important because the patient then knows that you've listened to them." (PPTID_03).

“I think as well that kind of rapport building is really key, and what I really like about MI is the focus on summaries as well. I think it can be quite easy to just ask question after question after question and not necessarily check in with the patient. And a way to show you’re understanding, and help them feel that you understand, cos I think that’s really important. (PPTID_04).

"my understanding is that with MI there isn't theory, well I guess it's underpinned by theory but no model as such. There's sort of key parts to it and you can talk about the spirit of MI, so I guess that was one tricky thing because as psychologists we really like models..." (PPTID_07).

"And it could be helpful for example if someone was really wanting to make a change in their life but they didn't know how or weren't confident in doing it, it's helping them to discover ways that they could. Through skills they already have, and skills they already possess, and I guess just sort of building that confidence but building the confidence from things that they have in themselves rather than a therapist doing to them. And I guess through a lot of reflections, change talk, what else, like open questions and summaries." (PPTID_07).

"Wheras in MI it's just reflections, summaries, looking for the change talk, amplifying things and all that, you know sort of skills. But like I guess there's no end point with MI." (PPTID_07).

“…I thought it was more of a structured thing than it is. It's more a principle now…. think it's more like a technique, an idea of making things more patient centered. Rather than what you want. Rather than when I first heard about it I literally thought it was like, I don't know, a more structured thing that you could just do. If you get given a spreadsheet or something.” (PPTID_10).

<u>Theme 2: Challenges in building competency</u>

[About reflective statements] *“They’re difficult to get a handle on, so they’re difficult to gain competency in.” (PPTID_01).*

“I suppose it wasn't difficult to learn about the theory, but the practice is difficult.” (PPTID_01).

“I have to change, me as a person. To be able to practice in this way, it’s not just the skill set. And the process of doing it - a lot of self-reflection.” (PPTID_02).

“They were doing things like, focusing and getting us to stand up as if we were pulling, when you do that you're talking about erm, basically about how to dance, and how when you're in a consultation and using MI, it should feel like you're complimenting each other and dancing, not a tug of war.” (PPTID_03).

“…like, it wasn’t really difficult, it’s not astrophysics is it, but because I think it’s just a new way of thinking.” (PPTID_03).

"I think I need an exact plan for maybe two or three exact, I understand that all people are different and our patients are different, but I need some material help to build it and they must be exact and very very correct questions that I need to ask them. Because all of the workshops they want, they were not very precise for me. And they were talking about the, you may have some different types of patient, they have different characters, they can have. They make different choices. There’s nothing I can really use in my practice from these workshops." (PPTID_05).

“…me reflecting on it and discussing it in supervision…applying it to the next session and seeing if it worked. So that was to support my learning really but also to hopefully support the client.” (PPTID_07).

"It was probably one of the better trainings that we had, I think just because well, one it's really interesting and I feel like a bit like solution focused, there's a real art to it. It's really difficult to teach, you just have to... I feel like you have to see someone do it. Just sort of learn as you go, what works, and try and do it yourself and find your own style. But I think the training that we had on the DClin, so what this guy offered, he was like really engaging, and the second one was as well, and in both I feel like the facilitators, reflecting back on it now I can see them using the skills of MI in their training and that's why it was so engaging. I look back now and think I see what you were doing." (PPTID_07).

"So yeah I find it really difficult, like MI it is challenging, and because it really takes a lot for me to take a step back and not step in to help people, in like a nice way, to really take a step back and let them do their thing. But in a way, it makes me wanna get better. Because when I see people do it really

well, or when we've had training, I'm like oh that's amazing, how do you do that? So yeah. It's hard, but when it's done well it's really good and I hope one day to be able to do it that well." (PPTID_07).

"“I think if you're taught that you know what, it's dead simple, anyone can do it, all you have to do is have a go and use your kind eyes, the main thing is the spirit of MI.” (PPTID_08).

“…a lot of MI courses vary quite a bit because there's so much scope to it.” (PPTID_13).

“…a decent level of competence to actually see benefits…would probably be at least two days or a week or something.” (PPTID_13).

“…it’s all practice…the important bit is that you are going on a course and practice it. Otherwise you lose confidence…I do think MI is not as straightforward as it might seem…” (PPTID_11).

"“when it was being explained to me it sounded really complex, compared to, ?(8:08-8:13) anything with a person-centred element. The trainer then said let me show you what I mean, and he modelled the approach and it made more sense. So, so that’s the sort of thing that I learn much more from…” (PPTID_12).

“Because fluency is where people recognise the words and think they know them, whereas mastery is where you can put it into practice. So it’s a bit more of a trend about helping people past the fluency, of recognising the word empathy, to practicing it.” (PPTID_12).

“For it to be effective, if you go online and watch the videos online, if you see somebody reading the tape, reading directions you can see it’s very, very stilted. It’s just not, that’s not really..It’s a good way to start, but not a good way to keep it going. Because you’re not sitting with empathy, or the client’s experiences. And that takes practice, that’s more of an art form.” (PPTID_12).

“I think there’s always a chance to practice. Whenever you’re speaking with anybody, you can choose to listen if you want. So people can practice listening, they can practice, practice finding affirmations, they might not have to say them out loud, but finding them in the person that they’re with. Or when watching the TV, they can practice reflective listening…” (PPTID_12).

"I think it was so hard to learn about in a theory side of things. So I, just as a uni course, and I did the two modules and I wasn't practicing it on a day to day basis, I just think it would be so hard and I wouldn't appreciate the value of it. Like when you're asking questions the natural thing is to ask 'are you ok?' which is a really closed question and not Motivational Interviewing, like it's really hard to train yourself to erm not be like that." (PPTID_14).

"But I do still feel there is room for improvement, I do sometimes ask closed questions and I do sometimes suggest answers for patients even though in the way that I was taught on the course is to say well, "may I make a suggestion for you?" And I try my best to do that, however most of the time I make that suggestion anyway." (PPTID_14).

Theme 3: Integrating MI into practice

"…we do things like reflections and active listening, obviously avoiding the righting reflect and so those are the principles that we go by. To be honest with you though, when you're in clinical practice you tend to kind of merge and develop your own kind of style with it…" (PPTID_03).

"So if the patient genuinely didn't know what to do, then obviously you can't use MI then because they don't actually have the answer. It's not a case of drawing it out. I think sometimes if, if you're in a situation where MI, they need more than, they need advice or expert opinion or expertise as a clinician, obviously you wouldn't be able to use it then. It's very rare that that happens so. I mean it happens occasionally, but it'll form a part of the consultation not the whole consultation, but I think patients know themselves very well. Patients are the experts of them, and they know what's putting them off doing things and being more physically active." (PPTID_03).

"You can use it in little bits, even in other therapy models that I use, having a knowledge of MI and thinking about how you give responsibility back to another person, just reflections and summaries in general, is really helpful." (PPTID_07).

"For example one of the big no-nos that you don't do in Mi is that you don't tell someone to do something because they're just gonna completely resist and back off and just, not do it. So I feel like that works in teams that I work in, in my home life, how I interact with my friends and understanding

why people do and don't do things. So yeah. I feel like, that, the second lot of MI training was just taking out little bits and stuff that you could do in work, in your personal life, in teams." (PPTID_07).

"I interweave, erm yeah. Although in like training you learn different distinct models what I found that clinical psychologists in practice have an integrative approach so they weave. You can see how they overlap, so like how CBT and ACT overlap, you can see how MI is actually like a thread that runs through them all I guess." (PPTID_07).

"It's not like a straitjacket, you put it on and you can't do anything else. It's a style." (PPTID_08).

"I think if you have an open mind, it is very, well the whole concept is exceedingly simple. It's not easy because we've been trained in…it's very easy if you allow yourself to believe it's the inner voice of I know what's best, if you can turn that off and you don't know what's best for somebody but you're really interested in them and they're going to decide what to do if anything." (PPTID_08)

"It's one of those things that you really need to be consciously in the present moment and know that you're using MI…it's not easy I don't think. I think the more you practice the more it becomes sort of embedded in what you're doing." (PPTID_11).

"I give them the opportunity and that's something I learned from MI, setting the agenda. Erm, so I am always very mindful of doing that right at the start." (PPTID_11).

"But at the same time, as part of my assessment I need to. There's information giving. It's not necessarily just gathering information from the patient. I need to tell the patient about the service that we offer so they can make an informed decision about if it's right for them or not. So the information gathering for me is does comply here there with MI, or it should do depending on how well I facilitate that, but part of the conversation is always going to be information giving, and that does not." (PPTID_14).

Theme 4: When to use and when not to use MI

"I was constantly coming up against conflict, getting frustrated and very judgemental about the group that I was working with, and why didn't they want to change, why can't they change, surely it's

straightforward. I probably searched out MI because it felt so uncomfortable and unrewarding, the work that I was doing, that there had to be a better way to do it, and MI gave me that then." (PPTID_02).

"I think that the thing with MI is that you develop skills that you use in any walk of life. I don't think that it's something for exclusive use in healthcare to be honest… my impression with MI is that it's the way you're thinking about things, and the way that you evaluate a situation, and developing a plan, from that. And I think it encourages a lot of reflection, so often, you know the answers to the problem it's just that sometimes you want to ask them the answer. You do know it, you just need to kind of reason how you're gonna sort it out." (PPTID_03).

"…the other end of the spectrum which you do very much to patients, intensive care for instance, if a patient is ventilated you're very much doing to patients, so obviously not really the capacity to do MI, and I think even when there's very early rehabilitation stages where they've had some kind of an operation or an injury or whatever it is, I think even then, I'm not sure how useful MI would be…" (PPTID_03).

"…things like the silences when you do Motivational Interviewing, because in normal conversations, there aren't really ever any silences, you tend to fill the void, it'll be a yes or a no or a nod, or whatever… so subtle, but so different to normal conversations." (PPTID_03).

"I think if someone needed very clear guidance, because they weren't, didn't have a clue and couldn't actually provide the answer, which is where my understanding of MI rests, on the patient knowing the answer, and then you , you have this consultation where you draw this out of them. So if the patient genuinely didn't know what to do, then obviously you can't use MI then because they don't actually have the answer. It's not a case of drawing it out." (PPTID_03).

"You get sort of overwhelmed by the volume of things that you have to talk about, you do start reading off a computer screen or asking closed questions because you're in a hurry." (PPTID_06, Professional Midwifery Advocate).

“I’ve seen first-hand what doesn’t work, lecturing people and the kind of scare tactics to people…it’s not very effective.” (PPTID_09, Health Trainer and Health Promotions Leader).

“It definitely depends on the individual, some people like to talk about their thoughts and feelings and some people don’t. You know, respond to a much more prescriptive approach.” (PPTID_09, Health Trainer and Health Promotions Leader).

“Kind of, you know almost... you have to kind of feed them, not feed them the answers, but coax them a bit more than perhaps it is made clear in the text and the training.” (PPTID_09).

“You can't ask questions when they aren't telling the truth about it. Um, so yeah I mean I think before I worked with people I kind of underestimated the extent to which people um...wouldn't actually talk. People often don't expect the fact that they can't motivate themselves. They just want to takl about it in practical terms, in terms of oh, um, you know, what kind of exercise should I do at the gym, and they won't say, I haven't been to the gym because I'm not motivated to go. Sometimes it's difficult to even have an MI conversation.” (PPTID_09).

“Although it should be like them coming up with the ideas and all this, sometimes you just have to tell them you know what I mean.” (PPTID_10).

“I think that depends on how long it takes, and the time it wouldn't be a problem if you know you have a regular appointment, they're going to come back, but people often don't.” (PPTID_10).

"I think for some patients they’re not very receptive to it. Some patients want to be told what to do, I get asked all the time, “I really need someone to give me a list of foods I can eat and foods I can’t eat.” And I’m never gonna do that, because there’s no such thing as food you can’t eat or food you can eat. I would write a diet plan for somebody and then they hate every food on it and they’re not going to comply, so what’s the point? Sometimes when we’re looking at say, patients coming to see me, so I’ll turn it round and say, “you’ve completed this for me, just briefly looking through here, you’re completing it, what are the changes you’d like to make?” And some will just look at me blankly and say, “well you tell me, you’re the expert.” (PPTID_14).

Theme 5: Impact of the external environment

"I think as a team we want to work in the best way, and of course you know, motivating and patient-centred approaches are recommended as best practice in weight management." (PPTID_01).

"People [colleagues] *started to realise that the things they were getting frustrated and stuck with, the conversations that were hard, I was able to share with them approaches that would help, so it's become more ingrained…we talk about the skills that we're using…it very much has become a departmental approach to use MI in all aspects of the work that we do." (PPTID_02).*

"When I started to develop my skills, I brought those back into the department... People started to realise that the things they were getting frustrated and stuck with, the conversations that were hard, I was able to share with them approaches that would help, so it's become more ingrained in our service now…I observe and coach members of staff in their skills, and people have observed me and we talk about the skills that we're using. So as well as the work that I do, it very much has become a department approach to use MI in all aspects of the work that we do." (PPTID_01).

"So if you're in an environment where they're open to change, they're open to trying new things, don't have all the answers, I think then they're gonna be much more supportive of trying things like MI." (PPTID_03).

"I think it's more the environment that you're in not necessarily the support but what everyone else is like. Like there's physios in [Place name] *who wouldn't be on board with this kind of thing. They wouldn't be on board because it's a bit woolly and it's a bit soft and they just wouldn't be on board with it." (PPTID_03).*

"…I think the more we can have those kind of open conversations, the more we can encourage people to use them or at least ask questions about what is it, or how does it work…" (PPTID_04).

"I'd like to know more…to what I'm doing, if there's anyone else out there in the same field as me in MI, how they... I guess it's a bit of buddying someone else… So I think it's, being in touch with fellow weight management psychologists working in MI I guess." (PPTID_11).

"…they might say I'm doing it for these people, here's the question, and then listen to experts from across the world as to what, you know here's some papers you might wanna read, here's a book that might be useful for you. Ah. It's very good. And you need it, it offers you a real community experience, so even though I'm based in [place name], *I can reach out and speak to anybody across the world." (PPTID_12).*

Theme 6: Enabling deep understanding of the person and their strengths

"I was constantly coming up against conflict, getting frustrated and very judgemental about the group that I was working with, and why didn't they want to change, why can't they change, surely it's straightforward. I probably searched out MI because it felt so uncomfortable and unrewarding, the work that I was doing, that there had to be a better way to do it, and MI gave me that then." (PPTID_02).

"I always understand why, for them to lose weight, I try to remind them of that." (PPTID_05).

"Spirit. To empower people. To, I guess really take a step back and encourage the other person to be aware of what skills and knowledge they hold, to cope in a situation or to change if that's what they wanna do. And like the practitioner not taking responsibility, but in a nice way. To pass responsibility to the other person to think about solutions or what might work. It's very, very very collaborative, but there's more responsbility on the client than the other person. And obviously much less responsbility on the therapist and it's just them guiding them and using those very specific skills and techniques to realise what they already know." (PPTID_07).

"Erm I don't know if they'd know on a conscious level like oh that's not MI and that is, but I feel like if you're adopting the spirit of MI it's that empowering of the person which feels much nicer. Whereas for example when I've shadowed nurses or doctors or whoever and they just say oh you know you really shouldn't drink that much alcohol it's bad for you you shouldn't do this and it interacts with that medication and that feels like, well I can imagine it feels quite blaming and quite helpless and like you've done something really wrong rather than taking an MI approach. That's like oh okay so you drink a lot of alcohol, like what are the pros and cons or you know offering information if they want to

rather than forcing it on them. So I feel like they'd know the difference and I feel like they'd feel a bit happier if they had an MI approach rather than if it wasn't. It's not nice. And it makes sense." (PPTID_07).

"I was fascinated, thinking about 'oh wow, what are they going to decide, that'll be nice. Every interaction was unique, it was interesting, and I wasn't the font of all knowledge repeating the same thing over and over again." (PPTID_08).

"So they need to feel safe and sometimes opening questions actually give them the opportunity to talk and say how they're feeling or what's happened to them. (PPTID_11).

"…ultimately I think it helps to empower the patient and to give them autonomy because you know, I don't like them to see me as the authority figure…it's more about them taking charge as well." (PPTID_11).

"…even when they're describing, inverted commas, 'bad behaviours', I'm trying to view it from their perspective." (PPTID_12).

"I would ask if I can help you and I would listen to their answer and I would begin there. My job as a practitioner is to understand the client from the client's perspective." (PPTID_12).

"I think with weight management it is the only way to get people to engage and also to make sure that the patient is at the centre of their care. I think with weight management, everybody knows what they need to do, which is to exercise more and eat less, but patients need to know how they can do that. And they know that the best and how to implement that. That really simple, it's a really simple task into their lifestyle." (PPTID_14).

"I think it's about putting patients at the centre of their care, or the centre of the discussion is a better way of putting it. And allowing them to generate their own goals, their own opinions, their own paths for moving forward." (PPTID_14).

Appendix i. Chapter 5 Ethical approval letter

Health and Life Sciences Research Ethics Committee (Human participants, tissues and databases)

14 January 2020

Dear Dr Chisholm

I am pleased to inform you that your application for research ethics approval has been approved. Application details and conditions of approval can be found below. Appendix A contains a list of documents approved by the Committee.

Application Details

Reference:	5724
Project Title:	Exercise Health Coaching: Research Study Testing a Motivational Interviewing Approach
Principal Investigator/Supervisor:	Dr Anna Chisholm
Co-Investigator(s):	-
Lead Student Investigator:	-
Department:	Psychological Sciences
Approval Date:	14/01/2020
Approval Expiry Date:	Five years from the approval date listed above

The application was **APPROVED** subject to the following conditions:

Conditions of approval

- All serious adverse events must be reported to the Committee (ethics@liverpool.ac.uk) in accordance with the procedure for reporting adverse events.
- If you wish to extend the duration of the study beyond the research ethics approval expiry date listed above, a new application should be submitted.
- If you wish to make an amendment to the study, please create and submit an amendment form using the research ethics system.
- If the named Principal Investigator or Supervisor changes, or leaves the employment of the University during the course of this approval, the approval will lapse. Therefore it will be necessary to create and submit an amendment form within the research ethics system.
- It is the responsibility of the Principal Investigator/Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

D Prescott

Health and Life Sciences Research Ethics Committee (Human participants, tissues and databases)

edreseth@liverpool.ac.uk

0151 795 4358

Appendix - Approved Documents

(Relevant only to amendments involving changes to the study documentation)

The final document set reviewed and approved by the committee is listed below:

Document Type	File Name	Date	Version
Questionnaire	Append F_Study surveys v1_060919	06/09/2019	1
Advertisement	Append A_Study advert v1_060919	06/09/2019	1
Participant Consent Form	Append E_Consent Form v1_060919	06/09/2019	1
Participant Information Sheet	Append D_Participant Information Sheet v1_060919	06/09/2019	1
Advertisement	Append A_Study advert v2_211119	21/11/2019	2
Participant Consent Form	Append E_Consent Form v2_211119	21/11/2019	2
Participant Consent Form	AppendB_Debrief sheet_v2_211119	21/11/2019	2
Study Proposal/Protocol	Protocol_v2_211119	21/11/2019	2
Participant Information Sheet	Append D_Participant Information Sheet v2_211119	21/11/2019	2
Study Proposal/Protocol	AppendC_Study Flow chart_v2_211119	21/11/2019	2

1

Appendix j. Chapter 5 Completed risk assessment

UNIVERSITY OF LIVERPOOL

RISK ASSESSMENT FORM

School/Department: School of Psychology	Building: Eleanor Rathbone Building
Task: Research sessions with adult participants one-to-one, involving discussion about their physical activity levels. Sessions may be face-to-face on the University of Liverpool campus. Potential for sessions to be conducted remotely via telephone if most convenient for participant. Sessions last approx. 1 hour.	
Persons who can be adversely affected by the activity: Researcher and participants	

Section 1: Is there potential for one or more of the issues below to lead to injury/ill health (tick relevant boxes)

People and animals/Behaviour hazards

Allergies		Too few people		Horseplay		Repetitive action		Farm animals	
Disabilities		Too many people		Violence/aggression	x	Standing for long periods		Small animals	

Poor training	x	Non-employees	x	Stress	x	Fatigue		Physical size, strength, shape	
Poor supervision	x	Illness/disease		Pregnancy/expectant mothers		Awkward body postures		Potential for human error	
Lack of experience	x	Lack of insurance		Static body postures		Lack of or poor communication		Taking short cuts	
Children		Rushing		Lack of mental ability		Language difficulties		Vulnerable adult group	

What controls measures are in place or need to be introduced to address the issues identified?

Identified hazards	What controls are currently planned or in place to ensure that the hazard identified does not lead to injury or ill-health?	RISK SCORE			Is there anything more that you can do to reduce the risk score in addition to what is already planned or in place?	RESIDUAL RISK SCORE		
		L	C	R		L	C	R
Non-employees	Participants are generally students of the university or friends of the researcher and so are familiar with the area. The participants will not be left alone and the researcher will accompany them out the building should the fire alarm go off. The researcher is trained in how to run conduct the interview.	1 1	1 1	1 1				

Poor supervision, poor training, lack of experience. Stress- Participants may feel upset by sensitive questions. Violence	Participants are given information sheets, which outlines the research activities ensuring participants are aware of the materials and activities involved in the study and are able to make an informed decision regarding participation. Participants are also informed that they are free to withdraw from the study at any time. On completion of the study participants will receive a full debrief including sources of further support if required and the researchers contact details. Participants will be recruited from the university. Should the researcher be concerned they should contact their supervisor or security on 2222 immediately.	1 1	1 3	1 3				

L = likelihood; C = consequence; R = overall risk rating

Section 2: Common Workplace hazards. Is there potential for one or more of the issues below to lead to injury/ill health (tick relevant boxes)

Fall from height		Poor lighting		Portable tools		Fire hazards	x	Chemicals		Asbestos	
Falling objects		Poor heating or ventilation		Powered/moving machinery		Vehicles		Biological agents		Explosives	
Slips, trips, falls	x	Poor space design		Lifting equipment		Radiation sources		Waste materials		Genetic modification work	
Manual handling		Poor welfare facilities		Pressure vessels		Lasers		Nanotechnology		Magnetic devices	
Display screen equipment	x	Electrical equipment	x	Noise or vibration		Confined spaces		Gases		Extraction systems	
Temperature extremes		Sharps		Drones		Cryogenics		Legionella		Robotics	
Home working		Poor signage		Overseas work		Overnight experiments		Unusual events		Community visits	
Late/lone working	x	Lack of/poor selection of PPE		Night work		Long hours		Weather extremes		Diving	

What controls measures are in place or need to be introduced to address the issues identified?

Identified hazards	What controls are currently planned or in place to ensure that the hazard identified does not lead to injury or ill-health?	RISK SCORE			Is there anything more that you can do to reduce the risk score in addition to what is already planned or in place?	RESIDUAL RISK SCORE		
		L	C	R		L	C	R

Use of electrical equipment, fire hazard.	All PCs and electrical equipment is PAT tested. Participants will complete Skype / telephone interviews using their own equipment.	1	3	3				
Use of PC	Researcher has completed a DSE							
Slips, trips and falls.	Cabling kept neat and tidy, good housekeeping, bags, coats etc stored correctly so as not to cause a trip hazard.	1	3	3				
Local emergency (eg building fire)	Researcher has been informed of the local emergency procedures.	1	5	5	Researcher will escort the participants out of the building should the fire alarm sound.	1	3	3
Personal Safety / lone working (including weekend work and evening work).	Research will only be carried out during normal working hours, Monday to Friday. The researcher will carry a mobile phone with her at all times. The supervisor has this number.	1	1	1				

L = likelihood; C = consequence; R = overall risk rating

Section 3: Additional hazards: are there further hazards NOT IDENTIFIED ABOVE that need to be considered and what controls are in place or needed? (list below)

Identified hazards	What controls are currently planned or in place to ensure that the hazard identified does not lead to injury or ill-health?	RISK SCORE			Is there anything more that you can do to reduce the risk score in addition to what is already planned or in place?	RESIDUAL RISK SCORE		
		L	C	R		L	C	R

Section 4: Emergency arrangements (List any additional controls that are required to deal with the potential emergency situation)

Emergency situation	**Additional control required**

Risk assessor (signature) Date. Authorised by (signature)...  Date: 10.2.20

COMPLETING THE RISK ASSESSMENT FORM

- School/Department – note down the School and/or Department where the task is being carried out
- Building – note the specific building(s) where the task is being carried out
- Task – specific clearly the task being carried out
- People would could be adversely affected – think of all the people who could be affected by what you are doing
- Hazards – tick all the relevant hazards in sections 1 and 2. If ticked you will need to log what controls are already in place to protect people from the hazard and what extra controls are required (if any) in the relevant control boxes. As part of the control measures you will need to make a decision of the level of risk based on the tables below. NB – it is likely that other hazards may exist that are not captured in sections 1 and 2. Section 3 should be used to capture any additional hazards and controls not listed in Sections 1 and 2.
- Emergency procedures – list the basic procedures that need to be taken if a critical incident occurs
- Signature – the people completing and approving the assessment must sign the relevant boxes at the end of the document
-

Likelihood	
1	Very unlikely
2	Unlikely
3	Fairly likely
4	Likely
5	Very likely

Consequence	
1	Insignificant – no injury
2	Minor – minor injuries needing first aid
3	Moderate – up to seven days absence
4	Major – more than seven days absence; major injury
5	Catastrophic – death; multiple serious injury

Consequences						
	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Likelihood				

- Additional control required - list any additional control required that will reduce the risk rating score. Ensure responsibilities for tasks and timescales are added
- Residual risk score – re-calculate the risk score after the introduction of the additional controls. Compare residual risk score with table below. Take further action if necessary.

ACTION TO BE TAKEN	
1-4 Acceptable	No further action but ensure controls are maintained

5-9 Adequate	Look to improve at next review.
10-16 Tolerable	Look to improve within specified timescale
17-25 Unacceptable	Stop activity and make immediate improvements

Appendix k. Chapter 5 Participant information sheet and consent form

Participant information sheet
(PIS)
06/09/19 V2

UNIVERSITY OF LIVERPOOL

Exercise Health Coaching Study

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to. Thank you for reading this.

What is the purpose of the study? To explore the effect of attending up to three health coaching sessions on physical activity behaviour and the psychological drivers of that behaviour.

Why have I been chosen to take part? We wish to invite any adult who has a wish to increase their physical activity in some way, to attend three 1-hour one-to-one health-coaching sessions that will take place in the University of Liverpool.

In order to take part you must:

- be 18 years old or over
- speak fluent English
- be able to travel to the University of Liverpool for three 1-hour coaching sessions within a six-week period (one session every two weeks)
- not currently have any health condition that prevents you from being able to engage in any physical activity
- have an interest in increasing your 'physical activity'

*By 'physical activity' we mean one of the following categories (1) a sport (e.g. football, tennis), (2) structured exercise (e.g. gym classes), or (3) unstructured activity (e.g. gardening / housework).

Do I have to take part? Participation is voluntary and up to the point of analysis of the findings, you are free to withdraw at any time (during or following study participation) without explanation and without detriment to yourself. We ask that you respond to us within a maximum of 1 month following this invite so that we can complete the study as planned.

What will happen if I take part? You will attend 3 x 1-hour health coaching sessions, at the University of Liverpool with a member of the study team who is trained in delivering behaviour change support. The sessions will take place over a 6 week period (1 session every 2 weeks). In these sessions you will have a discussion about physical activity and working towards increasing or enhancing your physical activity in a way that you wish to do so. You do not need to prepare anything before the sessions. At the beginning of session 1 you will complete a survey to identify your current physical activity behaviour and provide some basic demographic information. Following session 2 and session 3, you will again complete a survey reporting your current physical activity behaviour.

These sessions are intended to provide you with support to make changes to your physical activity behaviour. Research team members are not medically qualified, and cannot therefore provide advice or guidance regarding any physical or mental health concern. If any unanticipated concerns about your health or wellbeing arise during the study you will be advised to seek support from your GP and we can offer contact details for a range of other services that may be useful to you.

Each health coaching session will take place in a private room with one study member (Anna Chisholm or Harriet Makin) and sessions will be audio-recorded with your permission. Audio-recordings will be anonymised and transcribed verbatim.

How will my data be used? Data from this study will be presented within written reports and presentations and at no time will you be identifiable as all audio data will be referred to using a non-identifying ID number (e.g. ID_01) and any identifying information will be removed and replaced with generic labels (e.g. 'name' 'location'). Stored data from this study will be retained for a period of 10 years in line with University policy and then will be permanently destroyed. Data collected will be made publicly available through use of a general purpose data repository, e.g. Dryad. Any data that is made publicly available will be anonymised, and you will not be identifiable.

What will happen to the results of the study? The results of this study will be used towards BSc and PhD qualifications in Psychology. We also hope to publish the results of the study in scientific journals and present the findings at academic conferences. After the study is completed and ready for publication, the final study report will be made available at your request.

Expenses and / or payments. No financial payment or expenses are available for this study. *If you are a Year 1 BSc Psychology student currently at the University of Liverpool, you will receive up to 22 EPR points for participation based on attending three health coaching sessions and completing study surveys at 4 time-points.

Are there any risks in taking part? No disadvantages of taking part in this study are anticipated, however if any negative impact of participating in the study is experienced, please let a member of the research team know (contact details below). Additionally, if any health concerns arise as a result of reflecting upon your physical activity please seek support from your GP in the first instance and talk to the study team about other available resources that may be of help to you.

Are there any benefits in taking part? As a possible effect of attending health coaching sessions you may find benefits to your health or wellbeing related to making changes to physical activity behaviours.

What if I am unhappy or if there is a problem? If you are unhappy, or if there is a problem, please feel free to let us know by contacting [Dr Anna Chisholm; 0151 9741403 – Research Team Principal Investigator] and we will

try to help. If you remain unhappy, or have a complaint which you feel you cannot come to us with, then you should contact the Research Governance Officer at ethics@liv.ac.uk. When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

Who can I contact if I have further questions?

Matthew Hewitt (Student researcher)
Email: M.D.Hewitt@student.liverpool.ac.uk

Or

Harriet Makin (PhD researcher)
Tel: 0151 795 7511
Email: H.E.Makin@liverpool.ac.uk

Or

Dr Anna Chisholm (Principal Investigator)
Tel: 0151 7941403
Email: anna.chisholm@liverpool.ac.uk

UNIVERSITY OF LIVERPOOL

Participant Consent Form

Version number & date: v2 21-11-2019
Research ethics approval number:
Title of the research project: Exercise Health Coaching Study
Name of researcher(s): Anna Chisholm, Harriet Makin, Georgia Senior, Matthew Hewitt, Jean-Paul Ramirez-Zuniga, Zaynab Ahmed.

Please initial box

1. I confirm that I have read and have understood the information sheet dated 21-11-19 for the above study, or it has been read to me. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that taking part in the study involves attending three audio-recorded health coaching sessions (resulting in anonymised transcripts of these audio-recordings) and completing a survey about my physical activity at each health coaching visit. ☐
3. I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study at any time without giving any reason and without my rights being affected. In addition, I understand that I am free to decline to answer any particular question or questions. ☐
4. I understand that I can ask for access to the information I provide and I can request the destruction of that information if I wish at any time prior to the completion of data analysis from the study. I understand that following completion of the data analysis I will no longer be able to request access to or withdrawal of the information I provide. ☐
5. I understand that the information I provide will be held securely and in line with data protection requirements at the University of Liverpool until it is fully anonymised and then deposited in the Dryad Digital Repository archive for sharing and use by other authorised researchers to support other research in the future. ☐
6. I understand that signed consent forms and survey data and audio-data from this study will be retained in the University of Liverpool accessible only by the Principal Investigator until 10 years following study completion. ☐
7. I agree to take part in the above study. ☐

Participant name	Date	Signature
Name of person taking consent	Date	Signature

Principal Investigator
Name: Anna Chisholm
Telephone: 0151 7941403
Email: anna.chisholm@liverpool.ac.uk
Address: Eleanor Rathbone Building, Bedford Street South, Liverpool, L69 7ZA, UK

Student Investigator contact
Harriet Makin
Email contact: H.E.Makin@liv.ac.uk
Tel: 0151 795 7511

Participant ID number (tbc by the researcher):.....

Email (if participant wishes to receive a summary of the findings):.....

24

25

Appendix l. Chapter 5 Participant recruitment advertisement

Do you want support with increasing your physical activity?

Contact us

Find out more about taking part in this study by contacting the study research team. We will provide more information about the study and are happy to answer any questions or queries about involvement:

Email:
H.E.Makin@liverpool.ac.uk
Phone:
0151 795 7511

27 Appendix m. Chapter 5 Study surveys

28 # Baseline questions (T0 only)

Questions about you:	
Age (years)	
Sex (M/F/prefer not to say)	
Height (cm or ft/inches)	
Weight (kg or St/lbs)	
I am interested in increasing physical activity in relation to (please state): (1) a sport (2)structured exercise (3) unstructured activity	

Existing health conditions	

29

Participant ID (tbc by researcher):

IPAQ Physical Activity Questionnaire (T0, T2, T3)

*Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-95.

READ: I am going to ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

READ: Now, think about all the *vigorous* activities which take *hard physical effort* that you did in the last 7 days. Vigorous activities make you breathe much harder than normal and may include heavy lifting, digging, aerobics, or fast bicycling. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities?

   _____ Days per week [VDAY; Range 0-7, 8,9]

   8. Don't Know/Not Sure

   9. Refused

   [**Interviewer clarification**: Think only about those physical activities that you do for at least 10 minutes at a time.]

   [**Interviewer note**: If respondent answers zero, refuses or does not know, skip to Question 3]

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   __ __ Hours per day [VDHRS; Range: 0-16]

   __ __ __ Minutes per day [VDMIN; Range: 0-960, 998, 999]

   998. Don't Know/Not Sure

   999. Refused

   [**Interviewer clarification**: Think only about those physical activities you do for at least 10 minutes at a time.]

34 [**Interviewer probe**: An average time for one of the days on which you do vigorous activity is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask: "How much time in total would you spend **over the last 7 days** doing vigorous physical activities?"

__ __ Hours per week [VWHRS; Range: 0-112]
__ __ __ __Minutes per week [VWMIN; Range: 0-6720, 9998, 9999]
9998. Don't Know/Not Sure
9999. Refused

READ: Now think about activities which take *moderate physical effort* that you did in the last 7 days. Moderate physical activities make you breathe somewhat harder than normal and may include carrying light loads, bicycling at a regular pace, or doubles tennis. Do not include walking. Again, think about only those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities?

____ Days per week [MDAY; Range: 0-7, 8, 9]
8. Don't Know/Not Sure
9. Refused

[**Interviewer clarification**: Think only about those physical activities that you do for at least 10 minutes at a time]

[**Interviewer Note**: *If respondent answers zero,* refuses or does not know, skip to Question 5]

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

__ __ Hours per day [MDHRS; Range: 0-16]
__ __ __ Minutes per day [MDMIN; Range: 0-960, 998, 999]
998. Don't Know/Not Sure
999. Refused

[**Interviewer clarification**: Think only about those physical activities that you do for at least 10 minutes at a time.]

[**Interviewer probe**: An average time for one of the days on which you do moderate activity is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, or includes time

35 spent in multiple jobs, ask: "What is the total amount of time you spent over the **last 7 days** doing moderate physical activities?"

__ __ __ Hours per week [MWHRS; Range: 0-112]
__ __ __ __Minutes per week [MWMIN; Range: 0-6720, 9998, 9999]
9998. Don't Know/Not Sure
9999. Refused

READ: Now think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

____ Days per week [WDAY; Range: 0-7, 8, 9]
8. Don't Know/Not Sure
9. Refused

[**Interviewer clarification**: Think only about the walking that you do for at least 10 minutes at a time.]

[**Interviewer Note**: *If respondent answers zero,* refuses or does not know, skip to Question 7]

6. How much time did you usually spend **walking** on one of those days?

__ __ Hours per day [WDHRS; Range: 0-16]
__ __ __ Minutes per day [WDMIN; Range: 0-960, 998, 999]
998. Don't Know/Not Sure
999. Refused

[**Interviewer probe**: An average time for one of the days on which you walk is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask: "What is the total amount of time you spent walking over **the last 7 days**?"

__ __ __ Hours per week [WWHRS; Range: 0-112]
__ __ __ __Minutes per week [WWMIN; Range: 0-6720, 9998, 9999]
9998. Don't Know/Not Sure
9999. Refused

READ: Now think about the time you spent sitting on week days during the last 7 days. Include time spent at work, at home, while doing course work, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television.

7. During the last 7 days, how much time did you usually spend ***sitting*** on a **week day**?

__ __ **Hours per weekday** **[SDHRS; 0-16]**

__ __ __ Minutes per weekday [SDMIN; Range: 0-960, 998, 999]

998. Don't Know/Not Sure

999. Refused

[**Interviewer clarification**: Include time spent lying down (awake) as well as sitting]

[**Interviewer probe**: An average time per day spent sitting is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask: "What is the total amount of time you spent *sitting* last **Wednesday**?"

__ __ Hours on Wednesday [SWHRS; Range 0-16]

__ __ __ Minutes on Wednesday [SWMIN; Range: 0-960, 998, 999]

998. Don't Know/Not Sure

999. Refused

Participant ID (tbc by researcher):

Behavioural Determinants Survey (T0, T2, T3)

What area of physical activity would you like to change?	
Circle one number: 1=not at all; 7= totally agree	
I am capable of doing physical activity in my life	
I am confident that I can fit physical activity into my life	
Other people are supportive of me engaging in physical activity	
There is opportunity in my life to engage in physical activity	
I am motivated to do physical activity in my life	
I can fit physical activity into my life easily without having to think about it too much	

Participant ID (tbc by researcher):

Appendix n. Chapter 5 Data Management Plan

Audio data

Please describe how the data will be collected:

Health coaching sessions will be audio-recorded using a digital audio-recording device present at each health coaching session.

Please describe how the data will be stored:

Audio-files will be transferred and stored on a password protected University M drive directly after each health coaching session.

Please describe how long the data will be stored for and how this was decided:

Audio-data will be destroyed following completion of data analysis. This was decided upon to allow participants to be withdrawn (if they request to do so) for the longest possible time period following data collection. Transcripts are anonymised and so withdrawal from the study may not be possible unless audio-recordings are retained until this time.

Please describe the plans to ensure the data can be made available for re-use (e.g. open data, safeguarded data, or controlled data):

Audio-data will not be made available for re-use due to the potential for them not to be anonymous.

Please describe the plans for the destruction of the data:

Audio-files will be deleted from digital audio-recorders immediately following interviews and transferred to a secure University MDrive. Audio-files will be removed from the secure University M drive using software designed to remove data from the storage device.

Please explain who will have access to the data:

Only researchers named on the application will have access to the data.

Interview transcripts

Please describe how the data will be collected:

Anonymised transcripts will be created through a University approved transcription service. Audio-recordings of health coaching sessions will be transcribed verbatim.

Please describe how the data will be stored:

Transcripts will be stored on research team members' password protected University MDrives.

Please describe how long the data will be stored for and how this was decided:

Transcripts will be stored on the study supervisors M drive for 10 years following completion of the study. This was decided in line with the University policy for data archiving procedures of research data.

Please describe the plans to ensure the data can be made available for re-use (e.g. open data, safeguarded data, or controlled data):

Anonymised transcript data will be made available through the use of a general purpose research data repository, e.g. Dryad. Most repositories facilitate data archiving at the time of publication. Consistency with the Institutional policies will be ensured.

Please describe the plans for the destruction of the data:

Electronic copies of transcripts will be removed from the secure University M drive using software designed to remove data from the storage device.

Documents and scripts

Please describe how the data will be collected:

Survey data will be collected in person on written hard copies of surveys at 4 time points within the study. Consent forms will also be collected in person of hard copy paper forms.

Please describe how the data will be stored:

Surveys and consent forms will be stored in the principal investigator's locked file cabinet in the University of Liverpool.

Please describe how long the data will be stored for and how this was decided:

The data of study surveys and consent forms will be kept for 10 years following the end of the research project in line with the University policy for data archiving procedures of research data.

Please describe the plans to ensure the data can be made available for re-use (e.g. open data, safeguarded data, or controlled data):

For consent forms: N/A. For study survey data: data will be made available through the use of a general purpose research data repository, e.g. Dryad. Most repositories facilitate data archiving at the time of publication. Consistency with the Institutional policies will be ensured.

Please describe the plans for the destruction of the data:

Paper copies of the data will be shredded. Electronic copies (i.e. excel spreadsheets of survey responses) will be removed from the secure University M drive using software designed to remove data from the storage device.

Please explain who will have access to the data:

Only researchers named on the application will have access to the data.

Appendix o. Chapter 5 Participant debrief form

Study title: Motivating people to engage in physical activity: An intervention study to test the effects and application of motivational interviewing

'Exercise Health Coaching Study Debrief Sheet and Support Resource List'

Thank you for taking part in this research study. Although it is not the intention of this study, it is possible that as a result of taking part you may have reflected on your health and wellbeing in a way that you have not done so in the past. If this has raised any issues or concerns about your health or wellbeing please consider visiting your GP for support.

In addition, you may find some of the links below useful in providing support in a number of areas related to health and wellbeing.

If you feel you need further support or are feeling distressed, please contact:

- Your GP
- NHS 111
- NHS conditions: https://www.nhs.uk/conditions/
- Patient https://patient.info/
- Samaritans: 116123 (free to call and available 24 hours a day)
- mind: https://www.mind.org.uk/
- CALM: the Campaign Against Living Miserably 0800 58 58 58

131 Appendix p. Chapter 6 Data Management Plan and budget outlines

Data management roles	I am responsible for collecting and managing the research in conjunction with my supervisory team. The data will be made available in line with the University of Liverpool research data management policy. The quantitative survey data will be made available through the University repository. The audio recordings data will not be made available as it contains recordings of the participants and may make reference to details that would jeopardise anonymity. The PI will have access to all study data. The BSc students working on the project will have access to contact details of those recruited to take part, those who express an interest in taking part and request more information, and anonymised survey data (transcripts). External coding service providers will have access to limited audio data as stated on the research ethics application.
What type of research data will be produced?	Survey data Audio data from interviews
Software choices	Survey data: Excel for data organisation and SPSS for analysis (.csv and .spss files) Qualitative data: NVivo 12 (.mp3 for recordings)
Amount of data	Estimated amount – Up to 90 hours of audio (approx. 1.2GB per hour, 1.2*90 = 108GB audio) Excel sheet of data based on previous study = 24KB for ~20 participants completing 3 sets of surveys 24KB*3 = 72KB (<1.0 GB)
Sharing and ownership	It is expected that survey data will be made publicly available through the University repository. This data is anonymised and participants will not be identifiable.

	Audio recording data will not be made publicly available as it may contain recordings of the participants and may make reference to details that would jeopardise anonymity, such as place names or people names. Participants consent to their data being used for publication, future research projects, and are made aware on the PIS and consent form that quotes of their words may be used for publication. Participants data is anonymised and held separately to any identifiable details such as email addresses and contact telephone numbers.
Documentation and metadata	During the research, the project will keep a record of previous versions and the current working version. For all input data an Excel sheet containing reference to versions will be made available. This will be included in the long term storage of data so that it is easily identifiable for version control.
Short term storage	Data collected on devices e.g. Dictaphone and laptop computer will be transferred as soon as possible to the University password protected M drive and deleted from the original device. Audio data will be stored as .mp3 files. Survey data will be downloaded from the Qualtrics website into an Excel spreadsheet (.csv). This software will be used for data cleaning and organisation before being exported to SPSS (.spss). Data created from the audio files will be created in Excel (.csv). All data is to be stored on the University M Drive. I will also back up my files not immediately moved across (e.g. anonymised data, draft versions of write-up) from my personal laptop computer/external harddrive to the M drive at least twice a week.
Long term storage	I intend to store the data developed from this study after the conclusion of the project. The University offer long-term storage of data from PhD and other research projects, here:

	https://www.liverpool.ac.uk/csd/records-management/storage-and-disposal/
File naming and version control	Manuscript versions and analysis documents will be labelled using version numbers and dates. E.g. Cleaned_dataset_010121_v1.csv Cleaned_dataset_020121_v2.csv Analysis_document_030121_v1.spss Audio files will be labelled with the participant ID number, the date, and session number. E.g. PPTID_01_S1_010121.mp3 PPTID_01_S2_010221.mp3 Previous versions will be kept in a specific folder location titled 'Archive'.
Folders structure	Papers Data Audio files Audio files BCT coding (excel sheet) Audio files MI.T coding (excel sheet) Audio files MITI assessment (excel sheet) Survey data (excel clean sheet) Survey data analysis (SPSS file) Archive of previous versions Participant characteristics summary (SPSS file) Admin Spreadsheet with list of random ID numbers and which group they are allocated to Contact details for all participants Contact details for participants interested in future research (HELD SEPARATELY to other contact information and research data) Contact database noting date of last contact, date of next contact, next actions for the

	intervention group (noes not contain any outcome measurements) Master document with name, description, version number and location of all documents created
Who will have access to the data?	Dr Anna Chisholm (PI) Harriet Makin (PhD student) BSc Students named on the University of Liverpool Research Ethics committee application will also have access to the data. External individuals to the University will be provided with approximately 30% of audio files to complete fidelity assessments. Data will be transferred using secure methods and transferred data will use anonymised labels, e.g. "PPTID_01_S1_DATE". To transfer data we will use the UoL Datanywhere software; https://www.liverpool.ac.uk/csd/datanywhere/ which allows the transfer of data to external collaborators. They will be asked to delete the data once they have completed fidelity assessments.
Data Access Statement template	Anonymised survey data is accessible at [*DOI to repository here*]. Audio recordings and transcripts of the sessions are not available due to ethical concerns about maintaining the anonymity of participants.

132

Item	Quantity	Cost	Total	Cumulative total	Remaining balance (£1000 p.a., pending confirmation of 2019/20 remaining budget)	Notes
MITI course	1	180 (approx.)	180	120	820	
Facebook advertising	1 over 8 weeks	100	100	280	720	
Fidelity checking	16	50	800	1080	-80	
ICBM registration	1	120 (approx.)	120	1200	-200	
ICBM travel	0	0 (remote)	0	1200	-200	
ICBM accommodation	0	0	0	1200	-200	

133

134 Appendix q. Chapter 7 Ethical approval letter

UNIVERSITY OF LIVERPOOL

Health and Life Sciences Research Ethics Committee (Human participants, tissues and databases)

8 June 2020

Dear Dr Chisholm,

I am pleased to inform you that the amendment to your study has been approved. Amendment details and conditions of approval can be found below. If applicable, Appendix A contains a list of documents approved by the Committee.

Amendment details

Reference:	5724 (amendment)
Project Title:	Exercise Health Coaching: Research Study Testing a Motivational Interviewing Approach
Principal Investigator:	Dr Anna Chisholm
Co-Investigator(s):	-
Student Investigator(s):	-
Department:	Psychological Sciences
Approval Date:	08/06/2020

The amendment was **APPROVED** subject to the following conditions:

Conditions of approval

Please note: this approval is subject to the restrictions laid out in the Policy on research involving human participants in response to COVID-19. Therefore all face-to-face contact with human participants for the purpose of research should be halted until further notice; unless the study qualifies as one of the exceptions specified in the Policy and has been discussed with Research Ethics and Integrity team.

- All serious adverse events must be reported to the Committee (ethics@liv.ac.uk) in accordance with the procedure for reporting adverse events.
- If it is proposed to make further amendments to the study, please create and submit an amendment form within the research ethics system.
- It is the responsibility of the Principal Investigator or Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

D Prescott

Health and Life Sciences Research Ethics Committee (Human participants, tissues and databases)

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0151 795 4358

135

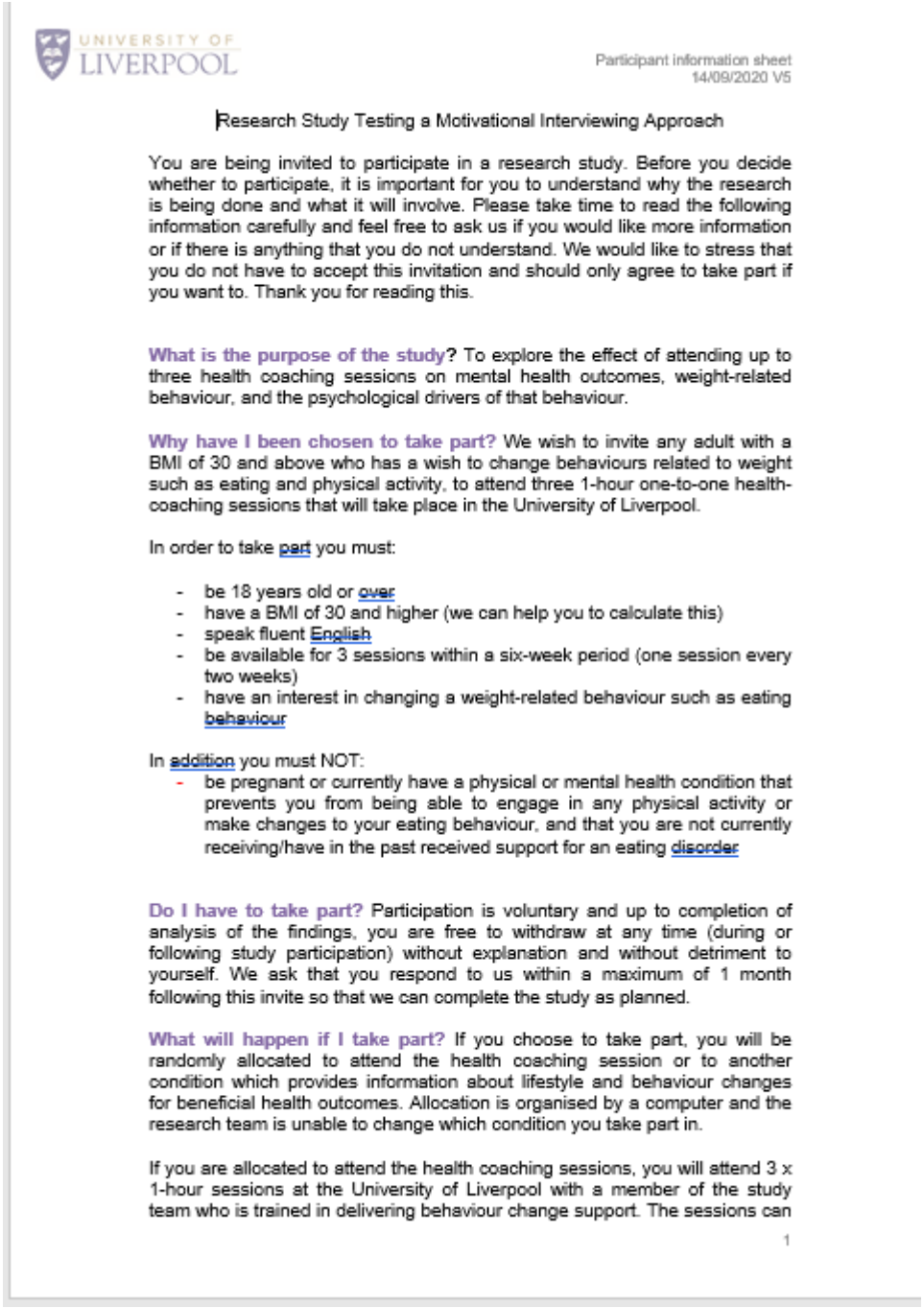
Appendix - Approved documents

If applicable, the final document set reviewed and approved by the committee is listed below:

Document Type	File Name	Date	Version
Default	Append A_Study advert v3_01062020	01/06/2020	3
Default	Append B_Debrief sheet_v3_01062020	01/06/2020	3
Default	Append C_Study Flow chart_v3_01062020	01/06/2020	3
Default	Append D_Participant Information Sheet v3_01062020	01/06/2020	3
Default	Append E_Consent Form v3_01062020	01/06/2020	3
Default	Appendix G_Screening survey v1_02062020	02/06/2020	1
Default	Append F_Study surveys v3_03062020	03/06/2020	3

137 Appendix r. Chapter 7 Participant information sheet and consent form

138



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Participant information sheet
14/09/2020 V5

Research Study Testing a Motivational Interviewing Approach

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to. Thank you for reading this.

What is the purpose of the study? To explore the effect of attending up to three health coaching sessions on mental health outcomes, weight-related behaviour, and the psychological drivers of that behaviour.

Why have I been chosen to take part? We wish to invite any adult with a BMI of 30 and above who has a wish to change behaviours related to weight such as eating and physical activity, to attend three 1-hour one-to-one health-coaching sessions that will take place in the University of Liverpool.

In order to take part you must:

- be 18 years old or over
- have a BMI of 30 and higher (we can help you to calculate this)
- speak fluent English
- be available for 3 sessions within a six-week period (one session every two weeks)
- have an interest in changing a weight-related behaviour such as eating behaviour

In addition you must NOT:

- be pregnant or currently have a physical or mental health condition that prevents you from being able to engage in any physical activity or make changes to your eating behaviour, and that you are not currently receiving/have in the past received support for an eating disorder

Do I have to take part? Participation is voluntary and up to completion of analysis of the findings, you are free to withdraw at any time (during or following study participation) without explanation and without detriment to yourself. We ask that you respond to us within a maximum of 1 month following this invite so that we can complete the study as planned.

What will happen if I take part? If you choose to take part, you will be randomly allocated to attend the health coaching session or to another condition which provides information about lifestyle and behaviour changes for beneficial health outcomes. Allocation is organised by a computer and the research team is unable to change which condition you take part in.

If you are allocated to attend the health coaching sessions, you will attend 3 x 1-hour sessions at the University of Liverpool with a member of the study team who is trained in delivering behaviour change support. The sessions can

1

139

also take place via telephone or video calling software such as Zoom or Skype. The sessions will take place over a 8 week period (1 session every 2 weeks). In these sessions you will have a discussion about weight related behaviours such as physical activity or eating behaviour and working towards changing behaviours in a way that you wish to do so. You do not need to prepare anything before the sessions. At the beginning of session 1 you will complete a survey to identify your current physical activity and eating behaviours, your emotions over the past week, how you are feeling about the desired behaviour change, and provide some basic demographic information. Following session 2 and session 3, you will again complete the survey reporting your current behaviours and how you are feeling. The surveys are anticipated to take between 10 and 15 minutes to complete at each session. We will also invite you to complete the survey 6 weeks after you have completed all sessions.

The coaching sessions are intended to provide you with support to make changes to your weight-related behaviour. Research team members are not medically qualified, and cannot therefore provide advice or guidance regarding any physical or mental health concern. If any unanticipated concerns about your health or wellbeing arise during the study you will be advised to seek support from your GP and we can offer contact details for a range of other services that may be useful to you.

If you are allocated to the information provision condition, you will be asked to complete 1 x 1-hour study session straight away, and 3 x 20 minute data collection sessions over the next 12 weeks. This will be delivered remotely via Qualtrics, a questionnaire hosting website. You do not need to prepare anything before the session. At the beginning of the session you will be asked to complete a survey to identify your current physical activity and eating behaviours, your emotions over the past week, how you are feeling about the desired behaviour change, and provide some basic demographic information. You will then be asked to watch a video providing information about lifestyle change for beneficial health outcomes which is approximately 40 minutes duration. We will contact you on two further occasions over the next 6 weeks and ask you to complete the surveys again. The surveys are anticipated to take between 10 and 20 minutes to complete in total. We will also invite you to complete the survey 6 weeks after you have completed all sessions.

Each health coaching session will take place in a private room with one study member (Anna Chisholm or Harriet Makin) or remotely via Zoom/Skype, and sessions will be audio-recorded with your permission. Audio-recordings will be anonymised and transcribed verbatim.

How will my data be used? Data from this study will be presented within written reports and presentations and at no time will you be identifiable as all audio data will be referred to using a non-identifying ID number (e.g. ID_01) and any identifying information will be removed and replaced with generic labels (e.g. 'name' 'location'). Stored data from this study will be retained for a period of 10 years in line with University policy and then will be permanently destroyed. Numerical survey data collected will be made publicly available through use of a general purpose data repository, e.g. Dryad. Any data that is made publicly available will be anonymised, and you will not be identifiable.

If you indicate on the consent form that you would be happy for us to contact you about future studies, we will retain the contact details that you provide us with. These will be stored separately to your study data. You will not be under any obligation to take part in future studies and if you decide not to consent to being contacted in future, it will not have any influence on your involvement in the current study.

We will also randomly select (up to) 30% of sessions to send 20 minute segments of audio recording for evaluation of how the study implemented the planned sessions. Your personal details, such as your name, will not be linked with the audio file, which will use a non-identifying ID number instead (e.g. ID_01). The evaluation will be carried out by an independent practitioner who has received specialised training to be able to assess the audio recordings.

What will happen to the results of the study? The results of this study will be used towards BSc and PhD qualifications in Psychology. We also hope to publish the results of the study in scientific journals and present the findings at academic conferences. After the study is completed and ready for publication, the final study report will be made available at your request.

Expenses and / or payments. No financial payment or expenses are available for this study. *If you are a Year 1 BSc Psychology student currently at the University of Liverpool, you will receive up to 22 EPR points for participation based on attending three health-coaching sessions and completing study surveys at 4 time-points.

Are there any risks in taking part? No disadvantages of taking part in this study are anticipated, however if any negative impact of participating in the study is experienced, please let a member of the research team know (contact details below). Additionally, if any health concerns arise as a result of reflecting upon your activity please seek support from your GP in the first instance and talk to the study team about other available resources that may be of help to you.

Are there any benefits in taking part? As a possible effect of attending health-coaching sessions you may find benefits to your health or wellbeing related to making changes to weight-related behaviours.

What if I am unhappy or if there is a problem? If you are unhappy, or if there is a problem, please feel free to let us know by contacting [Dr Anna Chisholm; 0151 9741403 – Research Team Principal Investigator] and we will try to help.

Who can I contact if I have further questions?

Harriet Makin (PhD researcher)
Tel: 0151 795 7511
Email: H.E.Makin@liverpool.ac.uk

or

Dr Anna Chisholm (Principal Investigator)
Tel: 0151 7941403
Email: anna.chisholm@liverpool.ac.uk

142

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Participant Consent Form

Version number & date: V4 & 14/09/2020
Research ethics approval number: 5724
Title of the research project: Research Study Testing a Motivational Interviewing Approach
Name of researcher(s): Anna Chisholm, Harriet Makin, Faye Moxham, Gracie Caine, Hannah Rees

Please initial box

1. I confirm that I have read and have understood the information sheet dated 14/09/2020 for the above study, or it has been read to me. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that taking part in the study involves attending three audio-recorded health coaching sessions at the University or via telephone or video-calling (resulting in anonymised transcripts of these audio-recordings) and completing a survey about my weight-related behaviours at each health coaching visit. ☐
3. I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study at any time without giving any reason and without my rights being affected. In addition, I understand that I am free to decline to answer any particular question or questions. ☐
4. I understand that I can ask for access to the information I provide and I can request the destruction of that information if I wish at any time prior to the completion of data analysis from the study. I understand that following completion of the data analysis I will no longer be able to request access to or withdrawal of the information I provide. ☐
5. I understand that the information I provide will be held securely and in line with data protection requirements at the University of Liverpool until it is fully anonymised and then deposited in the Dryad Digital Repository archive for sharing and use by other authorised researchers to support other research in the future. ☐
6. I understand that signed consent forms and survey data and audio-data from this study will be retained in the University of Liverpool accessible only by the Principal Investigator until 10 years following study completion. ☐
7. I understand that audio data I provide may be used for evaluation of how the research plans were implemented by a qualified independent evaluator. ☐
8. I agree to take part in the above study. ☐
9. I agree to being contacted at a later date and invited to take part in future studies. I understand that I am only agreeing to receive information and I am under no obligation to take part in any future studies. If you decide not to consent to being contacted in the future it will not have any influence on your involvement in this particular research study [and will not affect any standard of care that you receive. ☐

Participant ID number (tbc by the researcher):.....

Email (if participant wishes to receive a summary of the findings):.....

Participant name	Date	Signature
Name of person taking consent	Date	Signature

Principal Investigator
Name: Anna Chisholm
Telephone: 0151 7941403
Email: anna.chisholm@liverpool.ac.uk
Address: Eleanor Rathbone Building, Bedford Street South, Liverpool, L69 7ZA, UK

Investigator contact
Harriet Makin
Email contact: H.E.Makin@liv.ac.uk
Tel: 0151 795 7511

Participant ID number (tbc by the researcher):.....

Email (if participant wishes to receive a summary of the findings):.....

Appendix s. Chapter 7 Participant recruitment advertisement text for social media posts

Text for social media/local/email advertisements

We are recruiting UK-based adults with obesity (BMI of 30+) to take part in a study about behaviour change. You may be invited to 3 x 60 min chats with a researcher to explore what you're interested in changing + how you'd like to do it. We will ask you to complete surveys before, during and after so that we can evaluate effects of attending.

Please contact Harriet for more information @h.e.makin@liverpool.ac.uk

153 Appendix t. Chapter 7 Participant recruitment advertisement

Study advert - 15/09/2020 V5 Research ethics number 5724

WOULD YOU LIKE SUPPORT WITH CHANGING ANY KIND OF WEIGHT-RELATED BEHAVIOURS?

Study title: "Research study testing a motivational interviewing approach."

We are recruiting participants for a research study that will explore the effects of attending up to three sessions with a researcher on mental health outcomes, weight-related behaviour, and the psychological drivers of that behaviour.

What will happen if I take part?

You will be randomly allocated (by a computer) to receive **either** three x one-to-one sessions with a researcher who is trained in an approach called Motivational Interviewing, to have conversations that support you in making any change that you're interested in, **or** we will ask you to watch some videos that provide general advice about health and well-being. We will ask you to complete surveys when you begin the study, during the study, and after it has ended.

Who can take part?

In order to take part, we ask that you;

- are 18 years old or over
- have a BMI of 30 and above (we can help you to calculate this)
- English speaking
- are available to attend up to **three** sessions, lasting up to **60 minutes**, over a **6 week period**, and complete surveys before, during and after the study period. Sessions will be **remotely delivered** using video-calling (Zoom, Skype) or telephone.
- have a current interest in making a change to any weight-related behaviour (e.g. physical activity behaviour, eating behaviour)
- **and** that you are not currently pregnant, and do not currently have any kind of health condition which might prevent you from being able to make any kind of changes to your behaviour.

Who can I contact for more information?

Please contact **Harriet Makin** by email (h.e.makin@liverpool.ac.uk) or telephone (0151 795 7511) for a copy of the information sheet or to discuss the study further.

154

155

Appendix u. Chapter 7 Study surveys

Screening questions/baseline demographics (T0 only)

1. What is your age? (free text response)

2. What best describes your gender? (free text response)

3. What is your height?

    Feet and inches (free text response)

    Metres/centimetres (free text response)

4. What is your bodyweight?

    Kilograms (free text response)

    Stone and/or pounds (free text response)

5. What is your BMI?

    My BMI is under 18

    My BMI is between 18.00 and 24.99 (free text response)

    My BMI is between 25.00 and 29.99 (free text response)

    My BMI is 30.00 or above (free text response)

6. Have you ever discussed obesity with a healthcare professional before?

    Yes

    No

7. I confirm that I am not pregnant, or currently have a physical or mental health condition that prevents me from being able to engage in any physical activity or make changes to my eating behaviour:

    Yes

    No

8. I am interested in changing a weight-related behaviour such as eating or physical activity behaviour (please state what behaviours): (free text response)

9. In relation to the change I want to make… (sliding scale)

    -100 I have done a lot less

    0 I have done exactly what I wanted to do

    +100 I have done a lot more

.10 Please could you tell us a bit more about why you have provided this answer? (free text response)

11. Please list any existing health conditions that may impact on changing this behaviour: (free text response)

12. Please provide a random 5 digit number (we will send you a reminder of this for future surveys): (free text response)

13. Please provide a contact email address: (free text response)

14. Please provide a daytime contact telephone number: (free text response)

15. For UoL students only: Please provide your student number for EPR points allocation: (free text response)

Follow-up core outcome set (T3 only)

1. What is your bodyweight?

    Kilograms (free text response)

    Stone and/or pounds (free text response)

3. "Have you made use of any other resources (e.g. smartwatches, health-related apps, habit trackers, diaries or pedometers) during your involvement in the study? If so, please provide some additional detail about your use of these resources below: [FREE TEXT RESPONSE]"

213 # Behavioural Determinants Survey (complete T0, T1, T2, T3)

Behavioural Determinants Survey (complete T0, T1, T2, T3)

What is the one weight-related behaviour that you would like to change? (*Please state your main priority for change right now*)

1. I have the PHYSICAL opportunity to *change this behaviour*.

What is PHYSICAL opportunity?
The environment provides the opportunity to engage in the activity concerned.
(e.g. sufficient time, the necessary materials, reminders)

Please rate — Strongly disagree — Strongly Agree

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐

2. I have the SOCIAL opportunity *to change this behaviour*.

What is SOCIAL opportunity?

Interpersonal influences, social cues and cultural norms provide the opportunity to engage in the activity concerned

(e.g., support from friends and family)

Please rate — Strongly disagree — Strongly Agree

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐

3. I am motivated to *change this behaviour*.

What is motivation?
Conscious planning and evaluations (beliefs about what is good and bad)
(e.g. I have the desire to, I feel the need to)

Please rate — Strongly disagree — Strongly Agree

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐

4. *Changing this behaviour* is something that I do automatically.

Automatic motivation involves doing something without thinking or having to consciously remember

Participant ID (tbc by researcher): .....

214

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Study surveys
V6 20/01/2021
Changes are highlighted in red

(e.g. 'is something I do before I realise I'm doing it")

Please rate

Strongly disagree									Strongly Agree
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. I am PHYSICALLY able to *change this behaviour*.

What is PHYSICAL capability?

Having the physical skill, strength or stamina to engage in the activity concerned.

(e.g. I have sufficient physical stamina, I can overcome disability, I have sufficient physical skills)

Please rate

Strongly disagree									Strongly Agree
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. I am PSYCHOLOGICALLY able to *change this behaviour*.

What is PSYCHOLOGICAL capability?

Knowledge and/or psychological skills, strength or stamina to engage in the necessary thought processes for the activity concerned.

(e.g. having the knowledge, cognitive and interpersonal skills, having the ability to engage in appropriate memory, attention and decision making processes).

Please rate

Strongly disagree										Strongly Agree
1	2	3	4	5	6	7	8	9	10	11
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Participant ID (tbc by researcher): .....

IPAQ Physical Activity Questionnaire (complete T0, T1, T2, & T3)

*Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-95.

READ: I am going to ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

READ: Now, think about all the *vigorous* activities which take *hard physical effort* that you did in the last 7 days. Vigorous activities make you breathe much harder than normal and may include heavy lifting, digging, aerobics, or fast bicycling. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities?
   _____ Days per week [VDAY; Range 0-7, 8,9]
   8. Don't Know/Not Sure
   9. Refused

   [**Interviewer clarification**: Think only about those physical activities that you do for at least 10 minutes at a time.]

   [**Interviewer note**: If respondent answers zero, refuses or does not know, skip to Question 3]

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?
   __ __ Hours per day [VDHRS; Range: 0-16]
   __ __ __ Minutes per day [VDMIN; Range: 0-960, 998, 999]
   998. Don't Know/Not Sure
   999. Refused

   [**Interviewer clarification**: Think only about those physical activities you do for at least 10 minutes at a time.]

229 [**Interviewer probe**: An average time for one of the days on which you do vigorous activity is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask: "How much time in total would you spend **over the last 7 days** doing vigorous physical activities?"

__ __ Hours per week [VWHRS; Range: 0-112]
__ __ __ __Minutes per week [VWMIN; Range: 0-6720, 9998, 9999]
9998. Don't Know/Not Sure
9999. Refused

READ: Now think about activities which take *moderate physical effort* that you did in the last 7 days. Moderate physical activities make you breathe somewhat harder than normal and may include carrying light loads, bicycling at a regular pace, or doubles tennis. Do not include walking. Again, think about only those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities?

_____ Days per week [MDAY; Range: 0-7, 8, 9]
8. Don't Know/Not Sure
9. Refused

[**Interviewer clarification**: Think only about those physical activities that you do for at least 10 minutes at a time]

[**Interviewer Note**: *If respondent answers zero,* refuses or does not know, skip to Question 5]

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

__ __ Hours per day [MDHRS; Range: 0-16]
__ __ __ Minutes per day [MDMIN; Range: 0-960, 998, 999]
998. Don't Know/Not Sure
999. Refused

[**Interviewer clarification**: Think only about those physical activities that you do for at least 10 minutes at a time.]

[**Interviewer probe**: An average time for one of the days on which you do moderate activity is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, or includes time

230 spent in multiple jobs, ask: "What is the total amount of time you spent over the **last 7 days** doing moderate physical activities?"

__ __ __ Hours per week [MWHRS; Range: 0-112]
__ __ __ __Minutes per week [MWMIN; Range: 0-6720, 9998, 9999]
9998. Don't Know/Not Sure
9999. Refused

READ: Now think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

____ Days per week [WDAY; Range: 0-7, 8, 9]
8. Don't Know/Not Sure
9. Refused

[**Interviewer clarification**: Think only about the walking that you do for at least 10 minutes at a time.]

[**Interviewer Note**: *If respondent answers zero,* refuses or does not know, skip to Question 7]

6. How much time did you usually spend **walking** on one of those days?

__ __ Hours per day [WDHRS; Range: 0-16]
__ __ __ Minutes per day [WDMIN; Range: 0-960, 998, 999]
998. Don't Know/Not Sure
999. Refused

[**Interviewer probe**: An average time for one of the days on which you walk is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask: "What is the total amount of time you spent walking over **the last 7 days**?"

__ __ __ Hours per week [WWHRS; Range: 0-112]
__ __ __ __Minutes per week [WWMIN; Range: 0-6720, 9998, 9999]
9998. Don't Know/Not Sure
9999. Refused

READ: Now think about the time you spent sitting on week days during the last 7 days. Include time spent at work, at home, while doing course work, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television.

231

7. During the last 7 days, how much time did you usually spend ***sitting*** on a **week day**?

__ __ **Hours per weekday** **[SDHRS; 0-16]** 232

__ __ __ Minutes per weekday [SDMIN; Range: 0-960, 998, 999]
998. Don't Know/Not Sure
999. Refused

[**Interviewer clarification**: Include time spent lying down (awake) as well as sitting]

[**Interviewer probe**: An average time per day spent sitting is being sought. If the respondent can't answer because the pattern of time spent varies widely from day to day, ask: "What is the total amount of time you spent *sitting* last **Wednesday**?"

__ __ Hours on Wednesday [SWHRS; Range 0-16]
__ __ __ Minutes on Wednesday [SWMIN; Range: 0-960, 998, 999]
998. Don't Know/Not Sure
999. Refused

Eating behaviours survey (complete T0, T1, T2, T3)

Over the past 2 weeks how many pieces of fruit, of any sort, have you eaten on a typical day?
None One Two Three Four Five or more

Over the past 2 weeks how many portions of vegetables, excluding potatoes, have you eaten on a typical day?
None One ~~Two Three~~ Four Five or more

Over the past 2 weeks…

	Never	Rarely	Sometimes	Most of the time	Always
1. I continued to eat despite feeling full					
2. I served myself overly large portions					
3. I found it difficult to limit what/how much I eat					
4. I binged when eating					
5. When it came to food, I tended to over-indulge					
6. Once I started eating certain foods, I couldn't stop until there was nothing left					
7. I ate until I feel sick					
8. I didn't tend to overeat					
9. I felt unable to control my weight					

Survey reference: Appetitive Drive subscale from the Addiction-like Eating Behaviour Scale (AEBS; Ruddock et al., https://www.ncbi.nlm.nih.gov/pubmed/28676680).

WHO wellbeing index (complete T0, T1, T2, T3)

WHO (Five) Well-Being Index (1998 version)

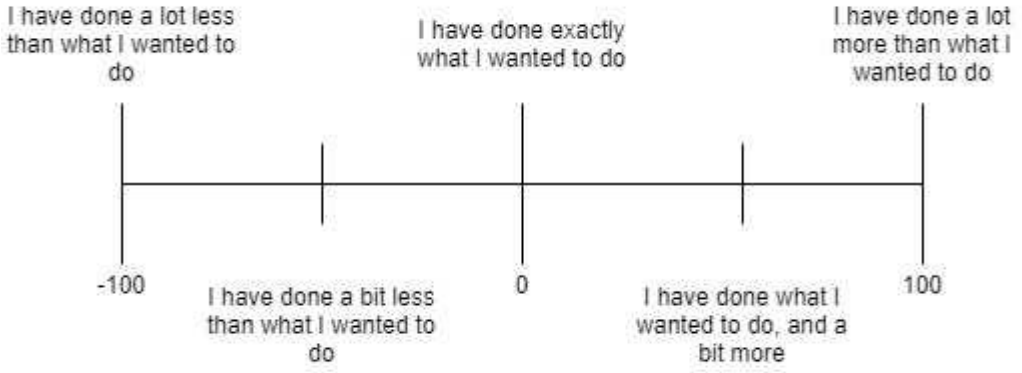
Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. Notice that higher numbers mean better well-being.

Example: If you have felt cheerful and in good spirits more than half of the time during the last two weeks, put a tick in the box with the number 3 in the upper right corner.

	Over the last two weeks	All of the time	Most of the time	More than half of the time	Less than half of the time	Some of the time	At no time
1	**I have felt cheerful and in good spirits**	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
2	**I have felt calm and relaxed**	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
3	**I have felt active and vigorous**	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
4	**I woke up feeling fresh and rested**	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
5	**My daily life has been filled with things that interest me**	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0

Behaviour change rating VAS (complete T0, T1, T2, T3)

In relation to the change I wanted to make...



Please could you tell us a bit more about why you provided this answer? I think [PIPED TEXT] because...

260 Appendix v. Chapter 7 Participant debrief form

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V3 Debrief sheet 01/06/2020

Study title: Motivating people to change weight-related behaviours: An intervention study to test the effects and application of motivational interviewing

'Health Coaching Research Study Debrief Sheet and Support Resource List'

Thank you for taking part in this research study. Although it is not the intention of this study, it is possible that as a result of taking part you may have reflected on your health and wellbeing in a way that you have not done so in the past. If this has raised any issues or concerns about your health or wellbeing please consider visiting your GP (general practitioner) for support.

In addition, you may find some of the links below useful in providing support in a number of areas related to health and wellbeing.

If you feel you need further support or are feeling distressed, please contact:

- Your GP
- NHS 111
- NHS conditions: https://www.nhs.uk/conditions/
- Patient https://patient.info/
- Samaritans: 116123 (free to call and available 24 hours a day)
- mind: https://www.mind.org.uk/
- CALM: the Campaign Against Living Miserably 0800 58 58 58

261

262