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Motivational interviewing and cognitive behaviour therapy in the treatment of adolescent overweight and obesity: Study design and methodology ☆

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Abstract

Background: Despite the high prevalence and negative physical and psychosocial consequences of overweight and obesity in adolescents, very little research has evaluated treatment in this population. Consequently, clinicians working with overweight and obese adolescents have little empirical research on which to base their practise. Cognitive behavioural therapy has demonstrated efficacy in promoting behaviour change in many treatment resistant disorders. Motivational interviewing has been used to increase motivation for change and improve treatment outcomes. In this paper we describe the rationale and design of a randomised controlled trial testing the efficacy of motivational interviewing and cognitive behaviour therapy in the treatment of overweight and obese adolescents.

Methods: Participants took part in a motivational interview or a standard semi-structured assessment interview and were then randomly allocated to a cognitive behavioural intervention or a wait-list control condition. The cognitive behavioural intervention, the CHOOSE HEALTH Program, consisted of 13 individual treatment sessions (12 face-to-face, 1 phone call) followed by 9 maintenance sessions (7 phone calls, 2 face-to-face). Assessments were conducted prior to participation, after the treatment phase and after the maintenance phase of intervention. Improvement in body composition was the primary outcome; secondary outcomes included improved cardiovascular fitness, eating and physical activity habits, family and psychosocial functioning.

Conclusion: Despite the demonstrated effectiveness of motivational interviewing and cognitive behavioural therapy in the long-term management of many treatment resistant disorders, these approaches have been under-utilised in adolescent overweight and obesity treatment. This study provides baseline data and a thorough review of the study design and treatment approach to allow for the assessment of the efficacy of motivational interviewing and cognitive behavioural therapy in the treatment of adolescent

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overweight and obesity. Data obtained in this study will also provide much needed information about the behavioural and psychosocial factors associated with adolescent overweight and obesity.

Keywords: Adolescent; Overweight; Obesity; Treatment; Cognitive behaviour therapy; Motivational interviewing; Randomised Controlled trial; Psychosocial

1. Introduction

It is currently estimated that approximately 25% of Australian young people are overweight or obese [1,2]. Rates have increased dramatically in recent years and there is nothing to suggest that the rate of increase is slowing [1]. Thus the prevalence of overweight and obesity is likely to continue to increase. Obesity tracks into adulthood such that an obese 13-year-old has a 50% chance of being an obese adult and an obese 18-year-old has nearly an 80% chance of being obese in adulthood [3]. The presence of obesity during childhood and adolescence increases the risk of numerous physical complications independently of adult obesity. Additionally, the longer the individual is overweight or obese, the more serious these physical complications become [3–6]. Consequently, the high prevalence of overweight and obesity in young people is particularly concerning.

Excess body weight is associated with increased mortality and morbidity rates. Numerous chronic and debilitating illnesses, including type II diabetes, coronary heart disease, some cancers and musculoskeletal disorders, and disorders that reduce quality of life such as arthritis, respiratory difficulties, skin problems, sleep apnea and infertility, are more common in overweight and obese individuals [7]. Many of these disorders, once thought to occur only in adults, are now being diagnosed in overweight and obese adolescents. Overweight and obesity also increase the risk of a variety of psychosocial problems including body image disturbance, low self-esteem, disordered eating and depression [8–10].

The strong tracking of adolescent obesity into adulthood, and the immediate and long-term negative biopsychosocial consequences of adolescent obesity, highlight the need for effective intervention in this population. Despite this identified need for treatment very few studies have explored the effectiveness of weight loss interventions for adolescents [11]. The relative neglect of adolescent obesity may be due to the complexities associated with studying this population. The study of adolescent body composition is made more complicated by the physical changes associated with puberty. Additionally, researchers may be hesitant to offer interventions to adolescents because of the difficulties associated with working clinically with this population. The lack of research in this area means clinicians working with adolescents have a limited empirical literature upon which to base their practice [11,12]. As a result "adolescents are in danger of falling in the 'gap' between paediatric services and adult services" [13, p. 50].

Only a small number of studies have systematically examined the effectiveness of overweight and obesity intervention in young people. The majority of these studies were too small to have sufficient power to detect an effect and they used various physiological measures making comparisons across studies difficult [11,12]. Consequently, several systematic reviews of the child and adolescent overweight and obesity treatment literature have concluded that it is not possible to conduct a meta-analysis using the existing studies [11,12]. The reviewers recommended that the standard of future intervention trials could be improved by conducting a priori calculation of sample size, using better randomisation methods, and reporting intention-to-treat analyses. It is also suggested that medical, behavioural and psychosocial outcomes and the psychosocial influences on behaviour change and predictors of outcome be explored. The inclusion of maintenance strategies and long-term follow up, and improvement of clinician attitudes and therapeutic techniques have also been identified as important for future research [11,12].

Given the lack of research exploring the treatment of adolescent overweight and obesity, the results of child and adult overweight and obesity interventions must be used as the basis for adolescent interventions. A number of studies of childhood interventions incorporating improved dietary habits, increased physical activity, reduced sedentary behaviour and parent training in behaviour management have demonstrated maintained weight loss up to 10 years after treatment [14,15]. Consequently, the use of a developmentally appropriate approach incorporating behavioural modification and family support to promote dietary change, increased physical activity, and decreased sedentary behaviour is recommended for the treatment of child and adolescent overweight and obesity [16]. While data on their long-term effectiveness is lacking, more intrusive treatment approaches such as very low calorie diets,

pharmacotherapy and surgery are being increasingly used with adolescents. The Australian National Health and Medical Research Council recommends that more conventional treatment strategies, namely eating and physical activity changes, family support and behaviour modification should be implemented prior to attempting more intrusive treatment techniques. They further advise that if medical treatments are implemented they should be preceded and accompanied by these lifestyle interventions [17].

Adult weight loss interventions have demonstrated some short-term success, however the majority of adult weight loss interventions have failed to demonstrate maintained improvements with most participants regaining all the weight they lost within 5 years [18,19]. The Australian National Health and Medical Research Council advocates a stepped model approach for the clinical management of overweight and obesity in adults. The model promotes education and lifestyle skills training as the initial approach for the treatment of adult overweight and obesity. More comprehensive cognitive behavioural interventions are recommended for those with patterns of cognitions, behaviours or emotions likely to impact on weight loss. While medical interventions such as very low calorie diets, pharmacotherapy and surgery are recommended for heavier individuals with existing co-morbidities, lifestyle changes resulting from cognitive behavioural intervention are considered fundamental additions to these more intrusive treatment approaches [20].

The majority of contemporary weight loss interventions focus on dietary change with the promotion of low-fat, low-carbohydrate or high-protein diets. Some more recent interventions also incorporate increased exercise or physical activity. To date, the majority of intervention approaches have been unable to produce the long-term behaviour changes that are required for sustained weight loss [19]. Stuart [21] revolutionised the weight loss field by incorporating behaviour therapy strategies, such as relaxation and stimulus control, into standard weight loss interventions. The incorporation of these strategies led to increased weight loss and improved maintenance in weight loss interventions. Behavioural strategies are now incorporated into most modern day weight loss interventions. However, since Stuart's [21] contribution, there has been very little extension of the role of psychology in the weight loss field.

In response to the increased demonstration of the effectiveness of cognitive behaviour therapy in the field of psychology, weight loss interventions have begun to incorporate cognitive behaviour therapy strategies. Cognitive behaviour therapy has been used extensively with adolescents and has demonstrated success in initiating and sustaining behavioural changes in a range of other disorders in [22]. However, the role of cognitions in obesity development and treatment and the potential use of cognitive behaviour therapy in obesity intervention have not yet been fully explored [23].

Motivational interviewing, a technique developed in the treatment of alcoholism and now used widely in the drug and alcohol field, aims to assist the individual to become ready for change [24,25]. This treatment approach has demonstrated success in initiating and sustaining behavioural changes in a range of other disorders [26,27]. Motivational interviewing has been used in conjunction with cognitive behaviour therapy to increase treatment initiation and completion rates and to improve treatment outcomes [e.g., 28]. However, the use of motivational interviewing in the treatment of overweight and obesity has received very little attention in the theoretical and empirical literature [27].

While there is a need for effective treatment of overweight and obesity in all age groups, the adolescent population is particularly in need of effective evidence based interventions. The tracking of obesity from adolescence to adulthood, combined with the treatment resistant nature of adult obesity, suggest that targeting this population may be an effective and efficient way to prevent adult obesity. Concomitantly, the high prevalence of adolescent overweight and obesity, and the increased biopsychosocial impact of being overweight at a younger age, and being overweight for a longer period of time, highlights the importance of targeting this at risk population immediately. Therefore, the primary aim of the present research is to examine the efficacy of cognitive behaviour therapy and motivational interviewing in the treatment of adolescent overweight and obesity. A secondary aim of this research program is to redress the limited information available on the behavioural and psychosocial factors associated with adolescent overweight and obesity.

2. Methods

2.1. Study procedures

2.1.1. Study design

This study was a randomised controlled trial in which 63 adolescents and their parents participated in either a motivational interview or a standard semi-structured assessment interview. Following completion of all pre-treatment assessments participants were randomly allocated to a treatment or wait-list control condition. Individuals in the treatment condition received 13 sessions of cognitive behavioural intervention over 4 to 6 months, those in the wait-list control did not

receive any intervention. Assessments were repeated at the end of this period. The RMIT University Human Research Ethics Committee required that participants randomly allocated to the control condition be offered treatment after a six month waiting period as it was deemed unethical to deny treatment for a longer period. Therefore those in the wait-list control condition were then offered treatment while those in the treatment condition participated in a maintenance program incorporating phone call sessions and face-to-face booster sessions. Assessments were repeated following this maintenance period. This data allows for comparisons between treatment and control conditions immediately following the treatment period, and for an analysis of changes from pre to post to maintenance in the treatment condition. It will also allow for assessment of the impact of motivational interviewing on the efficacy of the cognitive behavioural intervention by comparing the efficacy of cognitive behavioural intervention preceded by a standard assessment interview, and cognitive behavioural intervention preceded by a motivational interview. The anticipated primary outcomes will be improvements in body composition; secondary outcomes will include anthropometric measures, cardiovascular fitness, eating and physical activity habits, family and psychosocial functioning.

2.1.2. Study setting

Intervention and assessment sessions were conducted in the Psychology Clinics at RMIT University, Melbourne and Bundoora campuses. Physical assessments were conducted in the Exercise Physiology and Body Composition laboratories at RMIT University, Bundoora campus.

2.1.3. Ethical approval

Ethical approval for the project was obtained from the RMIT University Human Research Ethics Committee, the Department of Education and Training Victoria Ethics Committee, the Catholic Education Office Melbourne Ethics Committee and the Department of Human Services Radiation Safety Program. Voluntary written informed consent was required from both parent and adolescent participants.

2.1.4. Participant eligibility

Participants were included in the study if they met the following inclusion criteria: (a) aged 11 to 19 years, (b) overweight or obese according to the international cut-off points for body mass index in children [29], and (c) living with a parent or adult caregiver who was prepared to be involved in treatment. Participants were excluded from the study if they had an intellectual or physical disability that prevented them from participating in the program.

2.1.5. Recruitment, intake and registration

Information about the CHOOSE HEALTH program was circulated throughout the community via the media (e.g., radio, newspaper), school staff (e.g., principals, teachers, school nurses and welfare officers), health care professionals (e.g., medical practitioners, dietitians, nutritionists, maternal and child health nurses), health and fitness professionals (e.g., fitness instructors), and throughout RMIT University. All recruitment information requested that professionals, parents and/or adolescents contact the first author for more information about the program.

Parents who called regarding participation in the program were provided with a detailed outline of the research including a review of the treatment program and assessment procedures and details of the randomisation and wait-list process. Parents were then given the opportunity to ask questions before making a decision about proceeding. Those electing to proceed were asked to complete an intake survey administered over the phone. This survey was used to collect information about adolescent age, weight, height, previous weight loss attempts and the parent's motivations for participating in the program.

Parents were then mailed parent and adolescent plain language statements and a consent form and asked to return the consent form to register for the program. Voluntary informed consent was obtained from both parents and adolescents. If consent forms were not returned, a reminder letter and second consent form were forwarded to parents. Upon receipt of consent forms the first author contacted parents to schedule the assessment interview. Participants were then forwarded a confirmation letter, directions to the RMIT University Psychology Clinic, and the parent and adolescent survey booklets. All eligible families who registered interest in the project were accepted into the study.

2.1.6. Assessment interview

All assessment interviews were conducted by the first author, a postgraduate psychology student at the time of the study. Assessment interviews were conducted over a 60-minute period with both the adolescent and the parent present. If participants arrived late for the session they participated in the interview for the time that remained of the 60-minute

session. All initial interviews were videotaped for recording purposes and to ensure treatment fidelity. At the outset of the interview the interviewer obtained permission to videotape, outlined the limits to confidentiality and reviewed the purpose of the interview. The interviewer requested that the adolescent attempt to answer the interview questions, however, parents were also welcome to contribute information.

Those families allocated to the standard condition completed a standard semi-structured assessment interview based on the Parent and Adolescent Overweight and Obesity Assessment Interview Schedule [30]. This interview schedule was developed specifically for the purpose of this research to collect information on the home environment, medical history, past and present weight, food intake and eating behaviour, social and cognitive factors, daily activity, physical activity and sedentary behaviour of participants. The interviewer had previous training and experience in conducting semi-structured assessment interviews.

Families allocated to the motivational interview condition participated in a motivational interview aimed at increasing the adolescent's motivation to change their eating and physical activity behaviours. Techniques used in this session were based on motivational interviewing strategies described in Miller and Rollnick [24,25]. Prior to conducting the motivational interviews, the researcher received both Australian and international training in motivational interviewing which included didactic instruction and opportunities for practice with feedback from both training peers and trainers. Assessment interview videos were viewed by an independent observer and coded using the Motivational Interviewing Treatment Integrity (MITI) Code: Version 2 [31] to ensure assessment fidelity.

At the completion of the initial interview, adolescent and parent participants were given the option of continuing with the assessments or terminating their involvement in the program. Families wishing to continue with the program were then given instructions on monitoring their eating and physical activity habits and copies of the Self-Administered Physical Activity Checklist [32] and a weighed food diary were provided. Participants were also provided with a Manufacturing Technologies Incorporated Actigraph (Model 7164) and instructions for its use. The physical assessment session was explained and an appointment was scheduled. Participants were given an instruction sheet and a summary of the physical assessment session.

2.1.7. Allocation to condition

The first 34 families who registered for the CHOOSE HEALTH Program were allocated to the standard semi-structured assessment interview condition. The remaining 29 families were allocated to the motivational interview condition. As all initial interviews were being conducted by the first author it was deemed necessary to allocate families in this way to prevent the inadvertent use of motivational interviewing techniques in the standard assessment interview.

After completing all assessments, participants were asked to select a number and this was used to randomly allocate all 63 participants to the treatment or wait-list control condition. Those allocated to the treatment condition commenced treatment immediately. Participants allocated to the wait-list condition were informed that they would be contacted in six months and asked to repeat all assessments prior to commencing the treatment program.

2.2. Intervention

The CHOOSE HEALTH Program was developed for the purpose of this study. The first author, then a postgraduate psychology student, developed the program and delivered all intervention sessions.

2.2.1. Intervention goals

The primary goal of the intervention was to improve body composition and cardiovascular fitness in overweight and obese adolescents. As a result of the maturational changes that occur during adolescence, the inconsistencies in previous research, and the innovative non-prescriptive approach of the current program, it was not possible to determine specific body composition and cardiovascular fitness outcome goals. Rather than selecting arbitrary criteria for success, this program aimed to move participants closer to the healthy range for body composition and cardiovascular fitness.

The secondary goal of the intervention was to improve eating and physical activity habits. The nutritional component of the intervention aimed to promote eating habits consistent with the Australian Guide to Healthy Eating [33] which recommends the consumption of a variety of foods from each of the five food groups (cereals, vegetables, fruit, diary and meat products and alternatives), the selection of low-fat alternatives, and the consumption of water. The physical activity component of the intervention aimed to promote physical activity habits consistent with the

Australian physical activity guidelines for children and young people [34] which recommends adolescents achieve at least 60 minutes of moderate to vigorous physical activity per day and spend no more than two hours per day in non-educational screen activities. Rather than specifying goals in terms of specific caloric intake or expenditure targets, this program aimed to move participants closer to the Australian recommendations for eating and physical activity habits.

Given the large discrepancy between participant characteristics and recommendations for health, and the non-prescriptive nature of the program, the majority of participants were not expected to be within the healthy range at the termination of treatment. Rather than promote rapid unsustainable changes, the program aimed to instigate small maintainable improvements. Thus, it was predicted that changes would be evident post treatment and maintained or extended throughout the maintenance period.

Finally, the third goal of the program was to promote positive psychosocial functioning in participants. It was predicted that positive psychosocial functioning would promote maintenance of eating and physical activity changes, and thus sustained improvements in body composition and cardiovascular fitness. This program aimed to move participants closer to the normal range of psychosocial functioning if required, or maintain normal psychosocial functioning of those participants within the normal range. The normal range of functioning was defined by test publisher information or data collected from a local community sample.

2.2.2. Intervention format

Intervention was conducted on an individual basis. The intervention program consisted of a treatment and a maintenance phase.

2.2.3. Treatment phase

The treatment phase consisted of 12 one-hour face-to-face sessions and one phone call session. The first ten treatment sessions were conducted weekly. The remaining sessions were conducted every second week.

2.2.3.1. Session structure. Each treatment session commenced with a review of the previous session and a discussion of homework, goal achievement and monitoring. The session material was then introduced with the opportunity for discussion, questions and practice of the strategies. Adolescents were encouraged to complete the exercises (e.g., identifying opportunities for physical activity, reading nutritional labels, problem solving) within the session and were then assisted to set their own goals (e.g., walk part of the way to school, read nutritional labels and select a low energy snack, use problem solving if exercise goals not achieved) regarding use of the strategies prior to the next session. Each treatment session ended with a summary of the session material and setting of home practice tasks.

Both parents and adolescents were required to attend the first six treatment sessions. Adolescents were then given the choice of attending the remaining sessions alone, or with the support of a parent. Generally, older adolescents chose to attend alone while the younger adolescents preferred their parent to be present. Parents were also provided with written session materials for sessions 7, 8 and 9. Session 7 information discussed strategies for strengthening parent-adolescent relationship, Session 8, encouraging appropriate adolescent behaviour, and Session 9, discouraging inappropriate adolescent behaviour. Each session handout included information, exercises and an opportunity for the parent to set behaviour change goals. Parents were encouraged to work through these session materials independently and to contact the clinician to discuss any concerns or questions they had about the material.

2.2.3.2. Session content. Table 1 briefly outlines the content of each treatment session. The clinician based each session on a structured session outline which listed each of the topics that needed to be discussed and information about how to complete the exercises. This outline was also used as a measure of treatment adherence. At the completion of each session the clinician recorded which of the treatment components had been covered in the session.

Parents and adolescents also received a program workbook which included information, exercises and home practice tasks for each treatment session. Treatment session information sheets provided details of the topics discussed in the session and exercises to be completed during the session. At the end of each session adolescents recorded their self-selected behaviour change goals. Between sessions, adolescents were encouraged to monitor their behaviour change goals and record their eating and physical activity habits.

Table 1
CHOOSE HEALTH intervention sessions

Session	Topic	Content
1	Psycho-education	Information about definition, prevalence, causes and consequences of overweight and obesity, and common weight loss methods, CHOOSE HEALTH program strategies and aims, assessment findings, and setting treatment outcome goals.
2	Eating behaviour	Behavioural strategies to change eating habits, self-monitoring eating and physical activity habits, external control strategies to manage eating cues, behaviours and consequences.
3	Physical Activity	Behavioural strategies to reduce sedentary time and increase daily physical activity, external control strategies to managing activity cues, behaviours and consequences.
4	Healthy food choices	Information based on the Australian Guide to Healthy Eating, to improve diet quality and reduce fat consumption. Adolescent dietary monitoring used to target material.
5	Exercise	Strategies to establish a regular exercise routine and tackle the many barriers to exercise.
6	Behaviour charts and barriers	Review of program, behaviour change goals and progress towards self-measured treatment outcome goals. Develop reward system for goal achievement, identify environmental, social, personal (cognitive and emotional) and organisational barriers to behaviour change.
7	Recognising thoughts and emotions	Introduction to the cognitive behavioural model, recognise and record thoughts and emotions related to eating and physical activity habits.
8	Helpful thoughts and emotions	Identify and use positive coping strategies and statements to deal with difficult situations, challenge the validity and utility of negative cognitions.
9	Assertive communication	Use of assertive communication strategies when making a request, denying a request and acknowledging someone's assistance.
10	Problem solving and planning	Practice decision making and problem solving, time management, activity scheduling and planning.
11	Staying on track	Relapse prevention, identifying high-risk situations, planning ahead to manage these situations.
PC1	Maintaining change	Review behaviour change goals and coping plans, identify strengths and weaknesses, plan for high-risk situations.
12	Maintenance and closure	Review of program material, self-measured treatment goals and results of physical assessment, set goals for maintenance.

PC = phone call session.

2.2.4. Maintenance phase

The maintenance phase consisted of two 1-hour maintenance clinic sessions and seven 15-minutes maintenance phone call sessions. Following the last treatment session, phone call sessions were completed every second week and a face-to-face session was scheduled three months after the last treatment session. This was followed by monthly phone call session and a final face-to-face session conducted six months after the last treatment sessions.

2.2.4.1. Session structure. Phone call sessions continued with the same format as treatment sessions. Each phone call session commenced with a review of the information discussed in the previous session. Behaviour change checklists were reviewed and coping plans discussed. The adolescent was encouraged to identify the things they did well and any difficulties they experienced in the previous weeks. They were assisted to identify program strategies to address these difficulties in the future. The adolescent was then assisted to set their own goals regarding use of the strategies prior to the next session. They were also encouraged to develop coping plans for at least two high-risk situations they were likely to experience in the coming weeks. Each phone call session ended with a summary of the session and a review of the home practice tasks. Adolescents were encouraged to complete the phone call information sheet during the phone call.

Face-to-face sessions commenced with a discussion of self-measured treatment goals and results of the physical assessment. Behaviour change goals were reviewed and the adolescent was assisted to set goals for maintenance.

2.2.4.2. Session content. Table 2 briefly outlines the content of each maintenance phone call and face-to-face session. The clinician based each session on a structured session outline which listed topics to be discussed during the session. At the completion of each session the clinician recorded which of the session components had been covered in the session. Adolescents were provided with a phone call information sheet for each phone call session they completed. These sheets outlined the agenda for the phone call session and provided opportunities for the adolescents to list the points they wanted to raise during the phone calls and to record the information discussed during the session. At the end of each session adolescents were asked to record their self-selected behaviour change goals. Between sessions adolescents were encouraged to monitor their behaviour change goals and record their eating and physical activity habits.

Table 2
CHOOSE HEALTH maintenance sessions

Session	Topic	Content
PC1	Maintaining change	Review behaviour change goals and coping plans, identify strengths and weaknesses, plan for high-risk situations.
PC2	Maintaining change	As per phone call 1.
PC3	Maintaining change	As per phone call 1.
PC4	Maintaining change	As per phone call 1.
PC5	Maintaining change	As per phone call 1.
6	Maintenance	Review of self-measured treatment goals and behaviour change goals.
PC7	Maintaining change	As per phone call 1.
PC8	Maintaining change	As per phone call 1.
9	Maintenance	Review behaviour change goals and coping plans, identify strengths and weaknesses, plan for high-risk situations. Set goals for maintenance.

PC = Phone call session.

2.2.5. Intervention fidelity

Session content and structure was summarised in detailed session checklists and adherence to the treatment protocol was measured using these checklists. At the completion of each session, the clinician checked off the components that had been completed and provided a brief explanation for those components that were not completed.

2.3. Assessment

Assessments were completed after the assessment interview and prior to randomisation, after the completion of the treatment phase of the intervention (or the end of wait-list), and after completion of the maintenance phase of the intervention (for those in the treatment condition).

2.3.1. Physical assessments

Physical assessment sessions took approximately two hours to complete. They were conducted early in the morning with sessions scheduled to start from 7am to 8:45am. Participants were instructed to fast for 12 hours prior to their assessment. All physical assessments were conducted by trained independent assessors in the presence of a trained assistant. Assessors and observers were blind to participant's group allocation, treatment adherence, and stage of intervention. The treating clinician was not involved in physical assessment sessions.

2.3.1.1. Body composition. Body composition was determined through whole body scanning using a dual-energy X-ray absorptiometry apparatus (Lunar DPX densitometer). A total body scan was conducted to provide estimates of fat mass and lean tissue mass for the entire body and four sub-regions. A trained technician completed preparation of each scanned image, using appropriate anatomical landmarks to compartmentalise the body prior to application of the software and derivation of measures. Prior to commencement of the body scan female adolescents and their parents were questioned separately regarding the adolescents pregnancy status. No adolescents were pregnant while participating in the trial.

2.3.1.2. Anthropometics. Standing height was measured with a calibrated stadiometer to the nearest 0.5 cm and body weight was measured to the nearest 10 g on a calibrated set of digital scales. Body circumference measurements were taken from the right side of the body at the hip, waist, upper arm and forearm using a steel tape measure to the nearest millimetre. Anatomical landmarks were used to identify the location of each measurement point. Two separate body circumference measurements were made at each site and the mean score was recorded as the actual measurement. If there was more than a 1 cm discrepancy in the scores, a third measurement was taken and the mean of the two closest scores was recorded as the actual measurement. All anthropometric measurements were taken by a trained assessor.

2.3.1.3. Cardiovascular fitness. Cardiovascular fitness was measured using a laboratory-based cycle ergometer (Lode N.V Groningen, Netherlands) test and a field based multi-stage shuttle test [35]. During the laboratory-based cycle ergometer test participants wore a heart rate monitor and face mask while riding a cycle ergometer with resistance adjustments every 150 seconds until peak/maximum oxygen uptake was achieved. The test concluded when the participant

reached volitional fatigue or a respiratory exchange ratio greater than 1.1. Indices of cardiovascular fitness measured by this procedure included peak heart rate, peak/maximum oxygen uptake, peak power output and respiratory quotient.

Cardiovascular fitness was also determined for each participant through completion of a multi-stage shuttle test [35]. Each adolescent was tested separately. Participants were instructed to keep pace with the beep sound omitted from the compact disk player as they shuttled back and forth between two lines set 20 metres apart. Participants continue to run until they are unable to complete two consecutive shuttles in time with the beep or they voluntarily finish the multi-stage shuttle test.

2.3.1.4. Resting metabolic rate. Resting metabolic rate was determined through indirect caloriometry. After an overnight fast, participants attended the laboratory and lay on a plinth while a pneumotach mouthpiece was connected to sample expired air. Gas exchange (the amount of oxygen consumed and carbon dioxide produced) was measured on a MedGraphics metabolic measurement system (St. Paul, Minn., USA). Participants were then asked to lie quietly on the laboratory plinth for approximately 12 to 15 minutes while wearing a face mask that covered the mouth and nose. Resting oxygen consumption and respiratory exchange ratio were used to calculate resting metabolic rate.

2.3.1.5. Pubertal status. The Tanner [36] Scales of Sexual Maturity were used to provide a measure of adolescent sexual maturity. The Tanner Scales of Sexual Maturity comprises drawings of the development of pubic hair, scrotal and testes, and breasts. It is considered to be the best measure of sexual maturation in epidemiological studies [37].

2.3.2. Behavioural monitoring

Adolescents monitored their eating and physical activity for 7-days during each assessment period. Monitoring was scheduled for a typical school week. Participants were instructed to record for consecutive days where possible, however, if a day was missed, participants were asked to record for that day in the following week. Energy intake and expenditure were recorded on the same seven days. Participants were encouraged to record as regularly as possible to enhance the accuracy of the information. Parents were asked to provide their adolescent with as much assistance as they required to accurately complete their monitoring. Participants were instructed not to make any changes to their daily routine; instead, they were to continue with their usual habits. The analysis of all monitoring data was completed by an independent research assistant who was blind to treatment stage and condition.

2.3.2.1. Energy intake and nutritional intake. Energy intake was recorded using a 7-day weighed food diary. The food diary allowed for recording of the time of eating, the location, the amount, and type of food consumed. In addition to the verbal instructions given at the completion of the initial interview, written instructions and a sample food diary were provided to promote accuracy and compliance. Participants were encouraged to use electronic scales to weigh foods and Australian Standard measuring cups, spoons or jugs to measure foods and drinks. Parents were asked to provide their adolescent with as much assistance as they required to accurately complete the weighed food diary.

Food diaries were analysed using the FoodWorks Professional Edition 2005 (Version 4) program (Xyris Software Pty. Ltd.) and the AusNut food composition database. This product allows for comprehensive nutritional analysis including comparisons to recommended daily intakes and calculations of percentage of energy derived from protein, fat, and carbohydrate, and the ratio of saturated, mono- and polyunsaturated fats.

2.3.2.2. Energy expenditure and physical activity. Energy expenditure and physical activity was measured both directly using accelerometers and indirectly via self-report. The adolescents wore a Manufacturing Technologies Incorporated Actigraph (Model 7164) with an epoch set at 1 minute, during the 7-day monitoring period to assess the frequency, duration and intensity of their movement [38,39]. Participants wore the actigraph on their right hip attached using a firm fitting elastic belt strapped around their hips as per operator's instructions. Participants were instructed to begin wearing the actigraph when they woke on the first day of recording and to wear it at all times except when sleeping or in water. Adolescents were asked to note anything unusual that occurred while they were wearing the actigraph (e.g., home sick from school, swimming sports, up very late etc). Actigraph data was included in analyses if participants had worn the actigraph for more than ten hours, on five or more days including at least one weekend day.

Adolescents reported their daily physical activity and sedentary behaviour using the Self-Administered Physical Activity Checklist [32]. The Self-Administered Physical Activity Checklist provides a list of 21 physical activities,

with an opportunity to add activities not listed, respondents are asked to indicate the duration and intensity of any activities they have participated in during the previous 24 hours. This allows for the calculation of the number of minutes in physical activity, the number of minutes in moderate to vigorous activity, and the metabolic equivalent and weighted metabolic equivalent. The Self-Administered Physical Activity Checklist also includes a list of six sedentary activities, with an opportunity to add additional sedentary activities. Respondents are asked to indicate how many minutes they spent in each sedentary activity allowing for calculation of the total daily sedentary minutes.

2.3.3. Psychosocial assessments

Adolescent and parent participants completed comprehensive survey assessments at each assessment period. A considerable number of surveys were included in the assessment packages. Each was deemed necessary to obtain a comprehensive understanding of this population and to thoroughly evaluate the treatment program. The scoring of all survey assessments was completed by an independent research assistant who was blind to treatment stage and condition.

The adolescent survey battery included measures of demographic and background information, psychosocial factors, psychopathology, family interactions, eating and physical activity habits, motivation to change eating and physical activity habits, and assessments of treatment components. A summary of administered surveys is included in Table 3. A brief outline of each measure follows.

Table 3
Summary of adolescent and parent completed measures

	Adolescent	Parent
Background/demographics		
Health and weight history survey	✓	✓
Psychosocial functioning		
Rosenberg self-esteem scale	✓	✓
Perceived social support scale	✓	
Family and friend influence on health behaviour scale	✓	✓
Psychopathology		
Depression anxiety stress scale	✓	✓
Adolescent dieting scale	✓	
Eating disorders inventory — 2	✓	
Family functioning		
Parent–adolescent communication	✓	✓
Family problem solving communication index	✓	✓
Motivation for change		
Weight loss stages of change short form	✓	✓
Exercise stages of change short form	✓	✓
Exercise stages of change continuous measure	✓	
Exercise decisional balance scale	✓	
Weight loss decisional balance scale	✓	
Exercise self-efficacy scale	✓	
Eating self-efficacy scale	✓	
Exercise processes of change scale	✓	
Weight loss processes of change scale	✓	
Treatment components		
Fat, fruit and vegetables diet questionnaire	✓	
Youth behavioral risk survey — diet questions	✓	
Obesity knowledge test	✓	✓
Automatic thoughts questionnaire	✓	
Social skills questionnaire	✓	✓
Social competence questionnaire	✓	✓
Parenting scale		✓

The parent survey battery included measures of demographic and background information, psychosocial factors, psychopathology, family interactions, motivation to change eating and physical activity habits and assessments of treatment components. A summary of administered surveys is included in Table 3. A brief outline of each measure follows.

2.3.3.1. Background/demographics. The Parent and Adolescent Health and Weight History Surveys [30], measures designed specifically for the purpose of this study, were used to obtain general demographic information such as age and ethnic background and information about mental and physical well-being. Details of self-reported height, weight, weight perception, body dissatisfaction and previous weight loss attempts were also collected in this survey.

2.3.3.2. Psychosocial functioning. The adolescent survey battery assessed a range of psychosocial factors including self-esteem, and perceived social support. Parental self-esteem was also assessed. The Rosenberg Self-Esteem Scale [40] was used as the measure of self-esteem for both adolescents and parents. The Perceived Social Support Scale [41] was used as a measure of the individual's perceptions of the adequacy of their social support.

The Family and Friend Influence on Health Behaviour Scale was used as a measure of the involvement of family and friends on adolescents' adoption of health behaviour. It includes four subscales, family support for healthy eating, family support for physical activity, friend support for healthy eating, and friend support for physical activity. This measure was developed for the purpose of this study and is based on the Family Influences Health Behaviour Scale [42].

2.3.3.3. Psychopathology. Psychopathology variables assessed in the test battery included measures of general as well as eating and weight specific psychopathology. Parent and adolescent general psychopathology was measured using the Depression Anxiety Stress Scale [43]. Adolescent eating and weight specific psychopathology was measured using the Adolescent Dieting Scale [44] and the Eating Disorders Inventory — II [45].

2.3.3.4. Family functioning. Family interaction and communication surveys were completed by both adolescents and parents. These factors were measured using the Parent Adolescent Communication Scale [46] and the Family Problem Solving Communication Index [47].

2.3.3.5. Motivation for change. Weight loss and exercise measures of variables associated with the transtheoretical model of change, namely stages of change, processes of change, decisional balance and self efficacy, were also completed by adolescents. Stages of change were measured using the Weight Loss Stages of Change Short Form [48], the Exercise Stages of Change Short Form [49] and the Exercise Stages of Change Continuous Measure [49]. These measures allow for the classification of the participants' stage of change into precontemplation, contemplation, preparation, action or maintenance.

The individual's perceptions of the positive and negative aspects of exercise and weight loss were measured using the Exercise Decisional Balance Scale [50,51], and the Weight Loss Decisional Balance Scale [52]. These surveys provide information about factors influencing individuals' decision to exercise or lose weight. The Exercise Self-efficacy Scale [49] was used to measure confidence that they would exercise when faced with a range of common exercise barriers. The Eating Self-Efficacy Scale [53] was used to measure perceptions that they could control or resist urges to overeat in high-risk situations.

The Exercise Processes of Change Scale [50,51] and the Weight Loss Processes of Change Scale [48] were used to measure the covert and overt activities (consciousness raising, dramatic relief, environmental re-evaluation, self re-evaluation, social liberation, counterconditioning, helping relationships, self liberation, stimulus control) thought to influence progress through the stages of change.

2.3.3.6. Treatment components. In addition to the outcome measures listed above, a number of instruments were included to measure the efficacy of specific treatment components. These included measures of eating behaviours, knowledge related to obesity, cognitions and social skills.

Information regarding eating habits was collected using the Fat, Fruit and Vegetables Diet Questionnaire [54] and the dietary questions from the Centre for Disease Control Youth Behavioral Risk Survey [55,56]. The Obesity

Knowledge Test [57] was used as a measure of parent and adolescent knowledge of factors related to overweight and obesity and allowed for the assessment of the impact of psycho-educational aspects of the program.

A general measure of negative cognitions, the Automatic Thoughts Questionnaire [58] was included as a measure of the impact of cognitive restructuring components of the program. Assessment of social skills was required to determine the impact of assertiveness and social problem solving training on social competence. The pupil and parent versions of the Social Skills Questionnaire [59] and the Social Competence Questionnaire [59] were used as measures of the behaviours required for social competence. The parenting component of the program was assessed using the Parenting Scale [60,61].

2.3.4. Acceptability assessments

2.3.4.1. Consumer satisfaction. The CHOOSE HEALTH Consumer Satisfaction Survey [30] was developed for the purpose of this study. Both parent and adolescent versions were created. Respondents are asked to rate their overall satisfaction with the service, the program, the clinician response to concerns, and involvement in treatment, by answering 15 questions using a 5-point Likert scale ranging from 1 'never' to 5 'always'. There is also an opportunity for respondents to offer written feedback and suggestions. Consumer satisfaction was measured at the completion of the treatment phase of the intervention.

2.3.4.2. Drop out and completion measures. Participants completed a phone survey after completion or termination of the CHOOSE HEALTH Program. Those who did not complete the program were contacted and asked to complete the Non-Completion Survey [30]; those who completed the program completed the Completion Survey [30]. These surveys were developed for the purpose of this study.

The Non-Completion Survey commenced with a single open ended question regarding the participants' reason for discontinuing the program. This was followed by a list of 72 common factors impacting on completion. Respondents are asked to indicate whether each statement was true of them and if so to rate how much the item contributed to their drop out on a 3-point Likert scale from 0 'not at all', to 2 'a lot'. Respondents are also asked to provide suggestions for program improvements. The Completion Survey was identical to the Non-Completion Survey, however questions were rephrased to ask whether each of 72 common factors impacting on completion were true of them, and how much each item had impacted on their completion of the program.

2.4. Planned statistical analyses

Data will be analysed using SPSS. Analysis will be preceded by data cleaning and assumption testing. A series of analyses are planned.

The primary analysis will assess the efficacy of the cognitive behavioural intervention in the treatment of adolescent overweight and obesity. Treatment efficacy will be assessed by comparing the outcomes of the control and treatment conditions post treatment using a series of 2×2 between subjects Analysis of Covariance and Multivariate Analysis of Covariance with pre data entered as a covariate. The first factor will be condition (treatment, control) and the second factor gender (male, female). The maintenance of change will be assessed by comparing pre, post and maintenance outcomes using a series of 2×3 mixed factorial Analyses of Variance. The between-subjects factor will be gender (male, female) and the within subjects factor will be time (pre, post, maintenance).

The secondary analyses will consider the impact of motivational interviewing on the efficacy of the cognitive behaviour intervention by comparing the efficacy of cognitive behaviour therapy intervention preceded by a standard assessment interview, and cognitive behaviour therapy preceded by a motivational interview using $2 \times 2 \times 3$ mixed factorial Analysis of Variance. The first between-subjects factor will be condition (standard interview, motivational interview) and the second, gender (male, female). The within subjects factor will be time (pre, post and maintenance). For each of these analyses body composition will be the primary outcome variable, other physical and psychosocial variables will be explored in secondary outcome analyses. Both intention-to-treat and completer analyses are planned.

Further analyses will include exploration of the biopsychosocial predictors of treatment outcome; this will include an exploration of potential mediating or moderating variables. The relationship between physiological and psychosocial impacts of treatment will also be explored. A thorough analysis of treatment adherence, treatment compliance and other process variables is also planned.

Descriptive and correlational analyses of pre-treatment data will also be conducted. Similar data has been collected from a community sample of adolescents and parents in a separate study. This current treatment seeking sample of adolescents and their parents will be compared to normal weight and overweight adolescents from the community sample. Data will be analysed using a series of 2×3 between-subjects Analyses of Variance. The first factor group (normal, overweight, treatment) will consist of normal weight (normal) and overweight/obese adolescents (overweight) from the community sample, and overweight and obese treatment seeking adolescents (treatment). The second factor will be gender (male, female).

3. Results

3.1. Recruitment

Recruitment commenced in January 2003 with further major recruitment drives conducted in July 2003 and January 2004. Participants were assessed and randomised as soon as possible after recruitment. Those allocated to the treatment condition commenced treatment immediately after randomisation. The first participant commenced treatment in July 2003, and the final participant completed intervention in December 2005. A total of 120 parents completed intake questionnaires and were provided with plain language and consent forms. Eighty consent forms were returned, 75 participants commenced and 63 completed assessment. Fifty-four percent of participants completed a standard assessment interview and 46% a motivational interview. Thirty-three percent of participants were allocated to the wait-list control condition; the remainder participated in the CHOOSE HEALTH Program immediately after randomisation. This information is presented in Fig. 1 below.

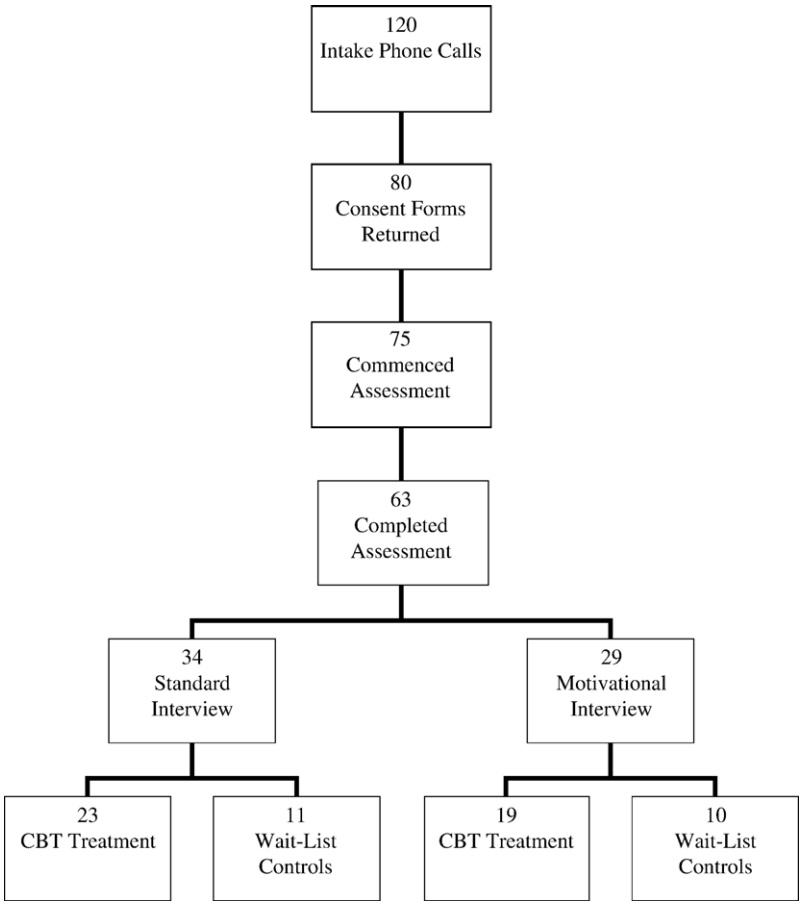

Fig. 1. Recruitment process from intake to group allocation.

3.2. Participant characteristics

The sample comprised 29 male and 34 female adolescents classified as overweight or obese according to the international reference standard BMI cut-off points [29]. The age of participants ranged from 11.5 to 18.9 years (M=14.3, SD=1.9). Seven percent of adolescent participants were in Year 6, 47% were in year 7 or 8, 23% in year 9 or 10, and 23% in year 11 or 12. Available Australian 2003 population data [62] for demographic information is included in brackets following each variable of interest.

Ninety-four percent of adolescent participants were Australian born and 81% identified themselves as Australian (Australia 76%). The sample also included 10% of adolescents identifying themselves as Italian, and 10% indicating that they identified with other ethnic groups. Ninety-eight percent of adolescents (Australia 84%) reported that English was the main language spoken at home. One adolescent identified himself as being of Aboriginal or Torres Strait Island origin (Victoria 6.1%).

Eighty-two percent of female participants reported that they had commenced menstruation and the age of menstruation commencement ranged from 9.3 to 15.3 years (M=12.5, SD=1.1). The percentage of males and females in each stage of sexual maturity [36] are presented in Table 4 below.

Sixty percent of adolescents reported that they had poor to fair physical health, and 67% indicated that they had good to excellent mental health (Australians 90%). Thirty-nine percent of adolescents reported that they had at least one health problem (Australian 78%), and 21% reported taking at least one regular medication. Asthma, joint problems, and allergies were the most commonly reported health problems with 21.3%, 6.6%, and 3.3% of adolescents respectively suffering from these disorders. Asthma medication, oral contraceptives, and antidepressants were the most commonly reported medications with 16.4%, 3.2% and 3.2% of adolescents respectively taking these medications.

The parent sample comprised 63 parents aged 28 to 61 years (M=44.8, SD=5.0). Ninety-four percent of parent respondents were biological mothers; however 5% of questionnaires were completed by biological fathers, and 2% by a step mother. Eighty-one percent of parent participants were Australian born and 74% identified themselves as Australian (Australia 76%). The sample also included 18% of parents identifying with European, 4% United Kingdom, 2% Asian, 2% Middle Eastern ethnic groups. One parent identified themselves as being of Aboriginal or Torres Strait Island origin (Victoria 6%). Forty-four percent (Australia 17%) of parents had university qualifications and 23% (Australia 22%) TAFE or trade qualifications and a further 7% (Australia 20%) had completed high school. Seventy-six percent of parent respondents were in paid employment (Australia 60% two parent families both parents are employed; 52% of one parent families one parent employed); of those employed, 43% were full-time workers (working 35 hours a week or more). Fifty-four percent of parents reported having good to excellent physical health and 86% indicated that they had good to excellent mental (Australia 90%).

Parent respondents also reported on their partner's ethnic background, education and employment. Sixty-nine percent of partners were born in Australia and 67% identified themselves as Australian (Australia 76%). No partners were identified as being of Aboriginal or Torres Strait Island origin (Victoria 6%). Eighty-eight percent of partners were in paid employment and of those, 98% were full-time employed working 35 hours a week or more (Australia 60% two parent families both parents are employed; 52% of one parent families one parent employed). Thirty percent of partners were university educated (Australia 17%), 35% had TAFE or trade qualifications (Australia 22%), a further 7% had completed high school (Australia 20%) and 24% had completed year 10.

Seventy-four percent of parent respondents were married or in de-facto relationships (Australia 78%) while 19% (Australia 22%) were divorced or separated and 7% had never married. Participating adolescents had an average of 1.4

Table 4
Percentage of adolescents at each stage of sexual maturity

	Tanner stage				
	1	2	3	4	5
Males					
Genital	19	33	22	22	4
Pubic hair	8	35	8	35	15
Females					
Breast	0	10	13	37	40
Pubic hair	3	3	17	43	33

siblings. Sixty-eight percent of parents reported that their adolescent lived with both biological parents, 21% of adolescents lived with only one parent, and 6% were living in a step family (Australia; 78% children live with two parents, 22% with one parent). Of the 95% of parents reporting family income, 12% of families were earning less than $25 000, 37% were earning between $25 001 and $50 000, 17% were earning between $50 001 and $70 000, and 35% were earning more than $70 000 per annum (Australian median parental income for couple families is $60 684, for single parents is $21 424).

4. Discussion

Despite the dramatic rise in the prevalence of adolescent overweight and obesity, and an increasing awareness of the negative physical and psychosocial consequences of this epidemic, few studies have explored the effectiveness of weight loss interventions for this age group [11,12]. Consequently clinicians working with adolescents have a limited empirical literature upon which to base their practice, and few treatment options are available for adolescents. While Australian guidelines recommend the use of cognitive behavioural interventions in the treatment of overweight and obesity [17,20], few empirically based interventions exist, and health professionals are rarely trained in the use of this approach in the treatment of excess weight. Cognitive behaviour therapy [22] and motivational interviewing [26,27] have demonstrated success in initiating and sustaining behavioural changes in a range of other disorders. This paper describes the rationale and design of the first randomised controlled trial testing the efficacy of motivational interviewing and cognitive behaviour therapy in the treatment of overweight and obese adolescents.

The findings of the present study will have a number of potential implications for obesity prevention and treatment. Results will provide much needed information about the use of cognitive behaviour therapy and motivational interviewing in the treatment of adolescent overweight and obesity. These findings will also have implications for the treatment of overweight and obesity in adults and children. The comprehensive assessment approach used in the current study will also provide much needed information about the impact of treatment on psychosocial functioning. Results of planned descriptive analyses will also inform prevention and treatment approaches. Findings of the current study will provide valuable information about weight related knowledge and perceptions of adolescents and their parents. Results will also allow for comparisons to be made between current Australian eating and physical activity guidelines for adolescents, and the habits of overweight and obese adolescents. The current study will also provide much needed information about the psychosocial functioning of treatment seeking overweight and obese adolescents.

This study has been designed to address many of the limitations of previous research as identified in recent reviews [11,12]. Firstly the study has sufficient power to detect an effect in primary outcome variables. Participants have been randomly allocated to a treatment or wait-list control condition, and a variety of physiological measures are planned to allow for comparisons across studies. Behavioural and psychosocial outcomes are also being comprehensively assessed. Psychosocial influences on behaviour change and predictors of outcome will also be explored. The intervention has been informed by theory and empirical research and has a particular emphasis on the maintenance of change. Finally, both intention-to-treat and completer analyses are planned.

While the design of the current study addresses many of the limitations of previous research, several methodological issues are acknowledged. The requirement that participants allocated to the wait-list condition be offered treatment immediately following the treatment period prevented comparisons between the treatment and control conditions in the longer term. Generalisation of findings may be limited by sampling bias. As the sample was recruited from the community, results may not generalise to adolescents seeking treatment in medical or community treatment settings. Due to financial constraints the lead author was both the clinician and evaluator. While steps have been taken to minimise confounding factors, this double role may result in an evaluator bias. The reliance on self-report data to measure psychosocial factors, and the use of indirect self-report measures of physical activity and energy intake, may result in self-report biases. Finally, the limited availability of measures specific to adolescent obesity necessitated the use of more general measures and this may influence study outcomes. Despite these limitations the current study will provide much needed information about adolescent overweight and obesity and its treatment.

5. Conclusion

In conclusion, we have described the rationale and design for a randomised controlled trial designed to assess the efficacy of a cognitive behavioural intervention for the treatment of adolescent overweight, and the impact of a

preceding motivational interview on the efficacy of this intervention. Baseline data has also been described. Findings from the present study will provide a comprehensive assessment of the biopsychosocial factors associated with adolescent overweight and obesity and its treatment. This study is timely given the increasing rates of excess weight in adolescence, and the lack of treatment options available to overweight and obese young people.

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