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Running head: MINDFULNESS BASED WEIGHT LOSS

Exploratory randomised controlled trial of a mindfulness based weight loss intervention for women

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Abstract

Objective: To explore the efficacy of a mindfulness based weight loss intervention for women.

Design: Sixty-two women (ages 19-64; BMI 22.5-52.1) who were attempting to lose weight were randomised to an intervention or control condition. The former were invited to attend four 2-hour workshops, the latter were asked to continue with their normal diets. Data were collected at baseline, 4 and 6 months.

Main outcome measures: BMI, physical activity, mental health.

Results: At 6 months intervention participants showed significantly greater increases in physical activity compared to controls ($p<.05$) but no significant differences in weight loss or mental health. However, when intervention participants who reported 'never' applying the workshop principles at 6 months (n=7) were excluded, results showed both significantly greater increases in physical activity (3.1 sessions per week relative to controls, $p<.05$) and significantly greater reductions in BMI (0.96 relative to controls, equivalent to 2.32kg, $p<0.5$). Reductions in BMI were mediated primarily by reductions in binge eating.

Conclusion: Despite its brevity, the intervention was successful at bringing about change. Further refinements should increase its efficacy.

Keywords: obesity, weight loss, mindfulness, physical activity, binge eating, ACT

Exploratory randomised controlled trial of a mindfulness based weight loss intervention for women

Introduction

Over the last two decades levels of obesity among British and American adults have trebled (World Health Organisation, 2003). Since obesity is associated with a wide range of health problems (Must et al., 1999), it impacts not only on quality of life, but also represents a substantial economic burden. Unfortunately, weight loss is difficult to achieve and even harder to maintain. For example, it is estimated that less than 5% of those who lose weight will have maintained these losses after 4 to 5 years (Kramer, Jeffery, Forster & Snell 1989). Research suggests that this is a result of the individual failing to maintain healthy eating and exercise habits (Jeffery et al., 2000; McGuire, Wing, Klem, Lang & Hill, 1999). Thus knowing *how* to lose weight is simply not sufficient, we also need to tackle the psychological processes that lead to behaviours associated with weight gain. Indeed, experts are increasingly recognising the need to address the psychological aspects of obesity (e.g., Byrne, 2002; Cooper & Fairburn, 2001; House of Commons Health Committee, 2004). Although a growing number of interventions are now incorporating components aimed at this (e.g., Cooper & Fairburn, 2001; Rapoport, Clark & Wardle, 2000), the development of these still falls far short of that achieved in areas such as nicotine and alcohol dependence to which obesity has been compared (House of Commons Health Committee, 2004).

Interventions to effect behaviour change in obesity management often draw on cognitive behaviour therapy (CBT). Such interventions generally incorporate both behavioural elements

such as cue avoidance, and cognitive elements such as challenging dysfunctional thoughts (e.g., Nauta, Hosers & Jansen, 2001; Rapoport, Clark & Wardle, 2000). Most recently motivational interviewing techniques have been included to increase the efficacy of traditional weight loss programmes (e.g., Carels et al., 2007).

The current study explored a different approach. Recent advances in psychotherapy suggest that mindfulness-based techniques and therapies may be an effective alternative to CBT for a wide range of clinical and non-clinical problems (Bishop et al., 2004; Hayes et al., 2006; Hayes, Masuda et al., 2004; Teasdale et al., 2000). Mindfulness can be described as a process whereby the individual observes their immediate experience using an open and non-judgemental stance (Bishop et al., 2004). Acceptance and Commitment Therapy (ACT) is a mindfulness-based therapy that has also been successfully used to treat addictive behaviours such as drug abuse and smoking. Of particular note is that in these cases ACT appeared to be as or more effective than traditional approaches when it came to the maintenance of behavioural changes (Gifford et al., 2004; Hayes, Wilson et al., 2004). Given the high relapse rates amongst dieters, an ACT based approach to weight loss may have potential.

What does ACT involve? ACT employs mindfulness strategies to target *experiential avoidance.* Experiential avoidance refers to attempts to avoid or control certain private events such as negative emotions, thoughts or bodily sensations (Hayes, Strosahl & Wilson, 1999). ACT interventions draw on a variety of mindfulness-based techniques and exercises to bring about a willingness to experience difficult thoughts, feelings and sensations rather than trying to avoid or control them. In doing so, the individual is able to abandon maladaptive behaviours normally used for avoidance and control and instead focus on behaviours that move them towards valued outcomes (Hayes et al., 1999).

How might ACT apply to obesity? There is evidence to suggest that obesity is associated with both *emotional eating* and *external eating*. Emotional eating refers to a tendency to overeat in response to negative emotions such as boredom, stress and unhappiness, whilst external eating refers to a tendency to overeat in response to food-related stimuli such as the taste, sight or smell of a palatable food (Van Strien, Schippers & Cox, 1995). Research shows that questionnaire measures of these types of eating behaviours are positively associated with BMI and obesity (Blair, Lewis & Booth, 1990; Braet & Van Strien, 1997; Delehanty et al., 2002; Hays et al., 2002; Wardle, 1987)[1]. Such measures have also been shown to be associated with retrospective accounts of adult weight gain (Hays et al., 2002, see also Kayman, Bruvold & Stern, 1990) and to predict weight regain following weight loss (McGuire et al., 1999). In addition, a study by Blair et al., (1990) found significant associations between levels of emotional eating and weight loss success; successful weight control was associated with decreases in emotional eating between baseline and a 1 year follow-up and with low levels of emotional eating at both time points. In contrast, unsuccessful weight control was associated with increases between baseline and follow-up and with high levels at both time points.

It is likely that experiential avoidance is involved in both emotional and external eating behaviours. Emotional eating occurs in response to negative emotions and there is evidence to suggest that it may be an attempt to distract attention from, or alleviate, these feelings (Tice & Bratslavsky, 2000, see also House of Commons Health Committee, 2004). If this is the case, emotional eating can be viewed as a form of experiential avoidance. In contrast, external eating

[1] Some of these measure *disinhibition of control* rather than emotional and external eating per se. Disinhibition is measured using the Three-Factor Eating Questionnaire (TFEQ) and refers to a tendency to overeat in response to disinhibiting stimuli such as negative emotions or the presence of palatable foods. The scale encompasses both emotional eating items and externality items (see Stunkard & Messick, 1985 and Van Strien, Frijters, Bergers & Defares, 1986) and there are highly significant correlations between measures of disinhibition and measures of emotional and external eating (Hill, Weaver & Blundell, 1991).

occurs in response to food cues and is therefore not necessarily prompted by an attempt to avoid or control negative feelings. However, where an individual is trying to lose weight, or eat healthily, and is attempting to resist overeating in response to these cues, it is likely that he or she will experience difficult thoughts, feelings and/or bodily sensations. For example, attempting to resist desert at a restaurant my elicit uncomfortable cravings. Failure to resist desert may therefore be viewed as an attempt to avoid or control these cravings and thus also a form of experiential avoidance. Since ACT directly targets experiential avoidance it may therefore be effective in bringing about reductions in emotional and external eating behaviours.

There is also evidence that bouts of overeating can be triggered by particular thoughts, for example about having broken ones diet (Ogden & Wardle, 1991). Likewise, failure to adhere to exercise and healthy eating plans may be prompted by rationalisations about, for example, being more conscientious the next day or there being exceptional circumstances that justify the relapse. An important component of ACT is *cognitive defusion,* helping the individual to see thoughts simply as thoughts, rather than as things that should necessarily be believed and followed. This technique helps individuals relate differently to their thoughts enabling them to choose to act in accordance with their personal values and life goals. Thus applied to the above cognitions it may help individuals refrain from bouts of overeating and adhere to exercise and eating plans.

Following recommendations for the development and evaluation of complex health interventions (Campbell et al., 2000), the aim of the current study was to conduct an exploratory trial of the effectiveness of a brief ACT-based group intervention. Given possible sex differences in psychological determinants of weight gain and loss, with females potentially engaging in more

emotional eating than males (Tanofsky, Wilfey, Spurrell, Welch & Brownell, 1997; Wardle et al., 1992; Wardle, 1987), the trial was restricted to females only.

Method

Sample size and recruitment

The target sample size was 60. There were no studies directly comparable to the present research but given attrition rates and effect sizes obtained in previous analogous investigations it was estimated this would provide an acceptable level of statistical power.

Participants were recruited by the third author (JI) via advertisements and articles in local newspapers, community and leisure centres, and on the university website. Eligibility criteria were a BMI of over 20 (this cut-off was selected to avoid excluding those who had been dieting for some time), over 18 years of age, actively attempting to lose weight, not pregnant, not using medications that influence weight, able to attend at least three of the four intervention workshops and no more than one participant per household. Figure 1 shows the flow of participants through the study. Eligible participants who attended a pre-trial appointment at the university and returned baseline questionnaires were entered into the randomisation process (62 in total). As a token of appreciation all participants were sent cheques for £25 (approximately 50 US dollars) on receipt of both the second and the final sets of questionnaires (see below). The study received ethical approval from the Cardiff School of Social Science Ethics Committee and informed consent was obtained.

INSERT FIGURE 1 HERE

Study design and randomisation

The study employed a randomised controlled trial design with quantitative data (questionnaires and BMI) collected at baseline, 4 months and 6 months. It also incorporated a qualitative evaluation, details of which are reported elsewhere (Tapper, Shaw, Ilsley & Moore, 2007).

Participants were allocated to the intervention and control conditions using a stratified randomisation protocol on the basis of BMI and the existence of medical conditions likely to effect weight (since these variables were considered most likely to influence study outcomes). The randomisation list was prepared by the first author (KT) using information provided by participants who returned registration forms (n=91). These participants were first divided into 'medical' and 'non-medical' groups according to whether, on the basis of British Heart Foundation guidelines (British Heart Foundation, 2004), they had an existing medical condition likely to affect their weight. Of the 91 participants, 10 were classified as having a medical condition and 81 as having no medical condition. Within the medical group, two strata were then formed using the median (self-reported) BMI and four strata were formed for the non-medical group by splitting participants into quartiles, again using self reported BMI. This resulted in a total of six strata, two for those with medical conditions (above and below a BMI of 28.81) and four for those without medical conditions (BMI ranges of $\leq$27.47, 27.48 to 30.24, 30.25 to 34.50 and $\geq$34.51). A block size of two was used for the medical group and a block size of four for the non-medical group. Following Pocock (1983), computer-generated random numbers were used to order intervention and control group allocation within each block.

Participant details (i.e. participant number, BMI and any medical conditions) were provided by JI in the order in which she received completed questionnaires. JI was blind to the number of strata and block sizes employed within the randomisation list. KT was not involved in

recruitment and was blind to participant identities. All participants were informed of the frequency of weight assessments (i.e. one at baseline and two follow-ups). Participants in the intervention condition were invited to attend the intervention workshops whilst controls were simply asked to continue their weight loss attempt as normal. No further information was provided to control participants but they were given the opportunity to attend a one-day weight loss workshop at the end of the study.

The sample had a mean BMI of 31.57 (SD=6.06, range=22.53-52.12) and a mean age of 41 years (SD=13, range=19-64). Table 1 shows the baseline characteristics across intervention and control groups. As shown, there were no significant differences in BMI, age (though intervention participants were, on average, slightly older than control participants), level of education, % of participants with medical conditions affecting their weight, % of participants attending formal slimming clubs, number of previous diet attempts, or length spent on current diet. However, participants in the intervention group reported starting dieting at a significantly older age than those in the control group (25 versus 20 years respectively, $p<.05$).

INSERT TABLE 1 HERE

Intervention

The intervention was designed to be used alongside participants' own weight loss plans. For these reasons only participants who were already attempting to lose weight were recruited and no dietary advice was provided. This was explained to participants at the start of the workshop sessions and reiterated when questions relating to specific diet strategies arose.

The intervention drew on selected concepts, exercises and metaphors previously employed in ACT interventions (Hayes & Smith, 2005; Hayes et al., 1999) and adapted these to the context of weight loss. Key intervention components were a) values, to enhance motivation, b) cognitive defusion, to help break links between food- and exercise-related thoughts and behaviour, and c) acceptance, to help the individual tolerate negative feelings. A summary of components employed, and their application to weight loss, is displayed in Table 2.

INSERT TABLE 2 HERE

The intervention was delivered by JI via a series of three workshops conducted over three consecutive weeks with a fourth follow up session taking place approximately three months later. The length of the treatment was based on that employed in previous brief ACT interventions that have produced successful outcomes (Bach & Hayes, 2002; Bond & Bunce, 2000; Metzler, Biglan, Noell, Ary & Ochs, 2000). Each session lasted two hours and included a powerpoint presentation and explanation of key concepts using metaphors, exercises and pen and paper tasks. Questions were encouraged during the session to ensure concepts were understood. JI, KT and CS had all attended a range of ACT training workshops and, as an informal assessment of treatment integrity, eight of the 12 workshops were observed by either KT or CS. During these sessions no problems relating to treatment integrity were identified.

Participants were also asked to complete a series of homework exercises in between each session. A manual was provided to accompany the workshops. This included details of key concepts and exercises, forms for pen and paper based tasks and details of homework. Participants also received a CD containing the four ‘eyes-closed’ exercises: ‘Leaves on a

Stream', 'Giving Feelings a Form', 'The Tin Can Monster Exercise' and 'Being Where You Are' (Hayes & Smith, 2005; Hayes et al., 1999). This was designed to support participants' practice at home.

It was acknowledged that in a real-world setting full workshop attendance by all participants was unlikely. A number of features were therefore incorporated into the design of the intervention to both maximise attendance and minimise the effects of non-attendance. First, three workshops following the same protocol were conducted each week with participants able to choose to attend either a daytime or evening session and vary the one they attended from week to week if other commitments intervened. (Sessions ran on Tuesdays at 6pm, Wednesdays at 7pm and Thursdays at 1pm.) Second, details of topics covered in each session were contained in the manual and those missing sessions were encouraged to read through these and complete the homework as usual. Third, each workshop session began with a recap of material previously covered, and lastly, the fourth follow-up workshop consisted of a more extensive recap of key intervention components.

Measures

Main outcome measures were as follows:

BMI (kg/m^2). Height was measured using the Leicester Height Measure (Invicta Plastics Ltd., Leicester) and recorded to the last completed millimetre. Weight was measured without footware to the nearest $1/10^{th}$ of a kilogram using Weight Watchers Heavy Duty Precision Electronic Scales. Participants' clothing was also recorded at baseline and participants were asked to wear similar clothing at later assessments. BMI was computed by dividing weight by squared height.

Brief Physical Assessment Tool (BPAT) to assess physical activity. The BPAT (Smith, Marshal & Huang, 2005) consists of three items recording a) the number of 30 minute bouts of moderate intensity levels of activity within a week, b) the number of 30 minute bouts of walking within a week, and c) the number of 20 minute bouts of vigorous levels of activity within a week. The questionnaire is scored as the total number of activity sessions per week with 20 minute bouts of vigorous activity counting as two sessions. It has been shown to have moderate test-retest reliability; fair to moderate concurrent validity and poor to fair criterion validity (Smith et al., 2005).

General Health Questionnaire-12 (GHQ-12) to assess mental health. The GHQ-12 (Goldberg, 1978) is a 12 item screening measure of current mental health status. Participants are asked to compare their recent experience of a particular symptom or behaviour with their usual level of functioning on a four point scale (0-3) ranging from 'less than usual' to 'much more than usual'. The questionnaire is scored from 0-36 with lower scores indicating greater mental health.

Hypothesised mediator measures were as follows:

Dutch Eating Behaviour Questionnaire (DEBQ) to assess emotional and external eating. The DEBQ (Van Strien, Frijters, Bergers & Defares, 1986) assesses emotional, external and restrained eating. It contains 33 statements each rated by participants as never / rarely / sometimes / often / very often. Only the emotional and external eating subscales were included in the present analysis (13 and 10 items respectively). Scores range from 1-5 with higher scores indicating higher levels of the behaviour. The DEBQ has been shown to have satisfactory to good reliability, excellent factorial validity and satisfactory concurrent and discriminant validity (Van Strien et al., 1986; Wardle, 1987).

Emotional Eating Questionnaire (EEQ) to assess emotional eating. This was a modified version of the Emotional Overeating Questionnaire (Masheb & Grilo, 2006) and assessed recent episodes of emotional eating. Participants recorded the number of days out of the last 7 (0-7) that they had eaten in response to a range of feelings (anxiety, sadness, loneliness, tiredness, anger, happiness). Internal reliability was moderate at baseline (alpha=0.47, n=62) but acceptable (alpha=0.62) with the exclusion of item 6 (happiness). Thus item 6 was excluded from all subsequent analyses.

Binge Eating Scale (BES) subsection to assess binge eating. A shortened version (6 items) of the BES (Gormally, Black, Datson & Rardin, 1982) was used to detect the presence of any of the cardinal features of binge eating, i.e. rapid consumption of large quantities of food and feelings and cognitions such as loss of control and fear of being unable to stop eating. The questionnaire was scored from 0-18 with higher scores indicating more severe symptoms. The scale showed acceptable internal reliability at baseline (alpha=0.74, n=62).

Acceptance & Action Questionnaire -II (AAQ-II) to assess acceptance and action. The AAQ-II (Bond et al., submitted) consists of 10 statements relating to the individual's willingness to experience difficult thoughts and feelings and the degree to which these interfere with their lives (*psychological flexibility).* Participants rated how true each statement was for them on a scale of 1-7. The AAQ-II has been shown to have good construct, concurrent, predictive and discriminant validity (Bond et al., submitted). The questionnaire was scored from 10 to 70 with higher scores indicating greater psychological flexibility.

Dietary adherence. Participants were asked to rate the extent they had adhered to their weight loss strategies over the previous seven days on a five-point scale ranging from 'never' to 'all of the time'. This measure was completed at baseline, and at the two follow-ups.

Hypothesised moderator variables were a) number of workshops attended, b) use of workshop principles during the programme, c) use of workshop principles at 6 month follow-up, d) workshop understanding, e) relevant value identification (i.e. motivation; Tapper et al., 2007), f) homework completion, and g) previous experience of meditation. Data for the number of workshops attended were obtained from registers whilst the remaining variables were assessed in a questionnaire administered at 6 months.

All data were collected by assistants who were blind to participant group allocation and who were otherwise uninvolved in the project. BMI was assessed at the university and questionnaires were collected by participants for completion in their own time. On receipt of questionnaires the assistant checked for missing data and, where necessary, contacted the participant to obtain these details. Five such participants were contacted at 4 months and 12 at 6 months.

Results

Baseline characteristics

Comparison of quantitative questionnaire measures between intervention and control groups at baseline showed that the intervention group scored significantly higher on the binge eating scale compared to controls, 9.1 (3.5) versus 7.2 (3.9) respectively, $t(60)=2.03$, $p<.05$, and reported significantly lower levels of physical activity, 5.3 (4.2) versus 7.3 (3.7) respectively, $t(60)=2.04$, $p<.05$. Other measures were well-matched (see Table 3).

INSERT TABLE 3 HERE

Workshop attendance

Of the 31 people randomised to the workshop condition, 26 attended one or more of the workshops, 1 attended half a workshop and 4 failed to attend any workshops. Attendance was highest at the start of the programme for Workshops 1 and 2 (n=25 and 24 respectively) and dropped off for Workshops 3 and 4 (n=18 and 16 respectively). (Three participants left halfway through a workshop. These have been recorded as not attending that workshop.) Nearly half the sample (48%) attended all four workshops whilst three-quarters (74%) attended two of the four workshops.

Intention to treat analysis

The data were first analysed on an intention to treat basis. As such, missing data were replaced by calculating the mean change from previous observations in the control group and adding or subtracting this figure from the previous observation relating to the missing data point. All means were in the predicted directions with BMI going down in the intervention group relative to the control group, physical activity showing an increase in the intervention group compared to a reduction in the control group and recent mental heath difficulties going down in the intervention group and up in the control group (see Table 4). However, the changes for BMI and mental health were relatively minor with small treatment effect sizes. Physical activity showed a slightly larger change with a moderate treatment effect size (see Table 4).

INSERT TABLE 4 HERE

A one-way MANOVA was used to examine the effects of the intervention on the three outcome measures. The independent variables were condition (intervention, control) whilst the dependent variables were the change scores for BMI, physical activity and mental health difficulties. Results showed a trend towards significance, $F(1, 58) = 2.31$, $p = .086$. Given the exploratory nature of the trial, follow-up tests were conducted. These showed no significant effect of the intervention on BMI, $F(1, 60) = 1.59$, $p = 0.21$, or on mental health difficulties, $F(1, 60) = 1.29$, $p = 0.26$, but a significant effect on physical activity, $F(1, 60) = 6.63$, $p<.013$.

Intervention efficacy

In order to examine the efficacy of the intervention itself, the above analysis was repeated but without replacing missing data. In addition, participants allocated to the intervention group who failed to attend any of the workshop sessions were excluded leaving a total of 23 intervention participants and 24 controls (23 for physical activity data, see Figure 1). Mean change scores between baseline and 6 months were calculated for each of the three outcome measures. These were all in the predicted directions with BMI going down in the intervention group relative to controls, physical activity showing an increase in the intervention group compared to controls and recent mental health difficulties going down in the intervention group and up in controls (see Table 4). Relative reductions in BMI in the intervention condition were equivalent to 1.35kg and increases in physical activity equivalent to 2.8 sessions. Effect sizes for changes over the 6 month duration were small for BMI and GHQ and moderate for physical activity (see Table 4). Independent t-tests revealed that, compared to controls, intervention participants showed a significantly greater increase in physical activity, $t(44)=2.46$, $p=.018$, but no difference in BMI change, $t(45)=1.40$, $p=0.17$ or change in mental health difficulties, $t(45)=0.87$, $p=0.39$.

Moderators

Further analyses were conducted to explore the effects of hypothesised moderating variables on change in both BMI and physical activity. Given the exploratory nature of the trial, and the large number of potential moderator variables relative to sample size, associations between moderator and outcome variables were initially explored using correlation coefficients. Several variables showed trends towards a relationship but without reaching statistical significance (see Tapper et al., 2007). The exception was the extent to which participants reported still applying the workshop principles at 6 months (assessed on a five-point scale from 'never' to 'a lot of the time'). This showed a significant correlation with BMI change of -0.51, $p<.05$ (and a non-significant correlation with physical activity change of 0.20).

In light of these findings, intervention effects were re-examined but this time excluding those intervention participants (n=7) who reported 'never' applying the workshop principles at 6 months. This left a total of 16 intervention participants and 24 controls. Mean change scores (and SDs) were -0.92 (1.58) and -0.04 (0.91) respectively for BMI, 2.50 (4.88) and -0.61 (3.34) respectively for physical activity, and 0.19 (9.76) and 0.88 (6.91) respectively for mental health difficulties. Relative reductions in BMI in the workshop condition were equivalent to 2.32kg. Independent t-tests revealed that, compared to controls, those in the intervention group showed significantly greater reductions in BMI, $t(38)=2.24$, $p=.031$ (effect size 0.20) and significantly greater increases in physical activity, $t(38)=2.36$, $p=.023$ (effect size 0.35). There were no group differences in mental health difficulties, $t(38)=0.26$, NS.

Mediators

The impact of the intervention on hypothesised mediators was then examined using the procedure recommended by Baron and Kenny (1986). Data from one control participant who become pregnant was excluded with the exception of her data for the AAQ. In addition, one intervention participant was no longer attempting to lose weight and therefore did not provide a rating for dietary adherence. Thus separate analyses were conducted for AAQ and dietary adherence.

Change scores (and SDs) from baseline to 6 months for intervention and control participants are shown in Table 5. A one-way MANOVA was used to examine the effects of the intervention on external eating (DEBQ), emotional eating (DEBQ), emotional eating (EEQ) and binge eating. Results showed a trend towards significance, $F(3, 41)=2.54$, $p=.054$. Given the exploratory nature of the trial, follow-up tests were conducted. Two independent t-tests were also used to examine the effects of the intervention on acceptance and action (AAQ) and diet adherence. As shown in Table 5, intervention participants showed a greater reduction in binge eating compared to control participants but there were no other significant differences.

INSERT TABLE 5 HERE

Associations between change in relevant mediator variables and change in relevant outcome measures were examined using Pearson's correlation coefficients. For BMI change results showed significant correlations with change in DEBQ emotional eating (0.35, $p<.05$) and binge eating (0.45, $p<.05$) but no significant correlations with change in external eating, EEQ emotional eating, AAQ and dietary adherence. For physical activity change results showed no

significant correlation with change in AAQ or dietary adherence. For mental health difficulties results showed a significant correlation with AAQ (-0.56, $p<.001$).

Given the above, hierarchical regression was used to examine whether the intervention brought about reductions in BMI via a change in binge eating. BMI change was first regressed on intervention at step 1 and binge eating change at step 2. Results showed a significant effect of the intervention ($R^2 = 0.13$, $\beta = 0.36$, $p<.05$), and a significant improvement in fit with the addition of binge eating change ($R^2 = 0.31$, $p<.01$). BMI change was then regressed on binge eating change at step 1 and intervention at step 2. Results showed a significant effect of binge eating change ($R^2 = 0.26$, $\beta = 0.51$, $p<.001$), but no significant improvement in fit with the addition of the intervention ($R^2 = 0.31$, $p=.15$). Thus the results suggest that the effect of the intervention on BMI was largely, but not wholly, brought about by reductions in binge eating.

Pearson's correlation coefficients revealed that increases in physical activity change were also significantly correlated with reductions in BMI ($r=-0.37$, $p<.05$). Thus, as above, the relationship between these three variables was tested using hierarchical regression analysis. Results showed a significant effect of the intervention on BMI change ($R^2 = 0.13$, $\beta = 0.36$, $p<.05$), and a trend towards a significant improvement in fit with the addition of physical activity change ($R^2 = 0.15$, $p=.099$). Results also showed a significant effect of physical activity change on BMI change ($R^2 = 0.14$, $\beta = -0.37$, $p<.05$), and a trend towards a significant improvement in fit with the addition of the intervention ($R^2 = 0.18$, $p=.11$). Thus the results suggest that a small proportion of the effect of the intervention on BMI may have been brought about by increases in physical activity.

Discussion

As far as we are aware the present study is the first attempt to adapt mindfulness based techniques for a programme designed exclusively for weight loss. Despite the exploratory nature of the trial, the results are promising with intervention participants losing 1.35kg more than controls at 6 months and showing a relative increase in physical activity of 2.81 sessions per week. When the data were re-analysed excluding those who reported 'never' using the workshop techniques at 6 months these figures rose to 2.32kg and 3.11 activity sessions per week. Weight and physical activity changes of these magnitudes, if sustained over time, should have clinically significant health benefits (National Heart, Lung and Blood Institute, 1998; Bucksch, 2005).

These weight losses are generally smaller than those typically reported for CBT programmes. However, the current programme was considerably briefer, amounting to a total of just 8 hours. This contrasts with the 20-40 hours generally employed in CBT programmes (e.g., Nauta et al., 2001; Rapoport et al., 2000). Increasing the duration of the current programme may therefore help increase its efficacy. Indeed, many participants reported that they would have liked a greater number of sessions (Tapper et al., 2007). However, given the drop-out rate it would seem wise to combine this with a screening measure to ensure that the intervention is targeted appropriately. Further work would be needed to identify those most likely to benefit from this type of approach.

A number of other modifications may also enhance the efficacy of the intervention. Qualitative data suggested that the most successful part was the cognitive defusion component, with participants finding it particularly useful in relation to exercise. This is consistent with the quantitative data showing significant increases in physical activity in the intervention group. Results also suggested that the change in BMI was mediated by a reduction in binge eating and it

seems likely that this too was brought about by the cognitive defusion component. For example, qualitative data suggested that intervention participants coped better after breaking their diet (for example by avoiding prolonged feelings of guilt and thoughts of failure) which may have helped interrupt previous patterns of diet lapses leading to binge eating episodes (Ogden & Wardle, 1991). Thus the cognitive defusion component could be emphasised in future with the application of these techniques to exercise and binge eating being made more explicit. However, it is important to note that the intervention group reported higher levels of binge eating, and lower levels of physical activity, at baseline

In contrast, participants reported some difficulty understanding and utilising the willingness/acceptance part of the programme, often confusing the aim with relaxation. This is consistent with the fact that the intervention had no significant impact on emotional eating, external eating or psychological flexibility. The intervention may therefore benefit from simplification and clarification of this component. The fact that change in emotional eating was significantly correlated with change in BMI reinforces the potential importance of addressing this type of eating behaviour.

The results also suggested that an important influence on intervention efficacy was whether participants were still applying the workshop principles at 6 months. Thus any modifications that could help bring about continued use of the programme principles would be likely to be beneficial. For example, placing more emphasis on helping participants integrate the principles into their daily lives may be one such modification. This might be achieved by getting participants to identify frequently encountered situations in which they are vulnerable to diet relapse (such as passing a vending machine on the way out of the office) and encouraging them to repeatedly apply a particular mindfulness-based technique. Such frequent repetition may help

make the techniques become more habitual and thus sustain them over a longer time period (Verplanken, 2005).

Finally, as noted previously, the present study was designed as an exploratory trial only and therefore subject to a number of limitations. In particular future evaluations should include a standard rather than no-treatment control, increase the length of the evaluation beyond 6 months and take account of clustering effects (i.e. the fact that the intervention was delivered in groups rather than to individuals). Additionally, as noted above, the intervention and control groups were not well-matched for physical activity and binge eating at baseline. Thus it would be important to replicate results relating to these variables in future work.

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References

Bach, P., & Hayes, S. C. (2002). The use of acceptance and commitment therapy to prevent the rehospitalization of psychotic patients: a randomised controlled trial. *Journal of Consulting and Clinical Psychology, 5,* 1129-1139.

Baron, R. M. & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bishop, S.R., Lau, M., Shapiro, S., Carlson, L., Anderson, N.D., Carmody, J. et al. (2004). Mindfulness: a proposed operational definition. *Clinical Psychology: Science and Practice, 11,* 230-241.

Blair, A.J., Lewis, V.J. & Booth, D.A. (1990). Does emotional eating interfere with success in attempts at weight control? *Appetite, 15,* 151-157.

Bond, F. W. & Bunce, D. (2000). Mediators of change in emotion-focused and problem-focused worksite stress management interventions. *Journal of Occupational Health Psychology, 5,* 156-163.

Bond, F.W., Hayes, S.C., Baer, R.A., Carpenter, K.M., Orcutt, H.K., Waltz, T. & Zettle, R.D. (Submitted). Preliminary psychometric properties of the Acceptance and Action Questionnaire – II: A revised measure of psychological flexibility and acceptance.

Braet, C. & Van Strien, T. (1997). Assessment of emotional, externality induced and restrained eating behaviour in nine to twelve-year-old obese and non-obese children. *Behavior Research Therapy, 35,* 863-873.

British Heart Foundation (2004). *Obesity (1 of 4): The causes of obesity*. London: British Heart Foundation. http://www.bhf.org.uk/factfiles.

Bucksch, J. (2005). Physical activity of moderate intensity in leisure time and the risk of all cause mortality. *British Journal of Sports Medicine, 39,* 632-638.

Byrne, S. M. (2002). Psychological aspects of weight maintenance and relapse in obesity. *Journal of Psychosomatic Research, 53,* 1029-1036.

Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A.L., Sandercock, P., Spiegelhalter, D. & Tyrer, P. (2000). Framework for design and evaluation of complex interventions to improve health. *British Medical Journal, 321,* 694-696.

Carels, R.A., Darby, L., Cacciapaglia, H.M., Konrad, K., Coit, C., Harper, J., Kaplar, M.E., Young, K., Baylen, C.A. & Versland, A. (2007). Using motivational interviewing as a supplement to obesity treatment: A stepped-care approach. *Health Psychology, 26,* 369-374.

Cooper, Z. & Fairburn, C. G. (2001). A new cognitive approach to the treatment of obesity. *Behaviour Research and Therapy 39,* 499-511.

Delahanty, L. M., Williamson, D. A., Meigs, J. B., Nathan, D. M. & Hayden, D. (2002). Psychological and behavioral correlates of baseline BMI in the diabetes prevention program (DPP). *Diabetes Care, 25,* 1992-1998.

Gifford, E.V., Kohlenberg, B.S., Hayes, S.C., Antonuccio, D.O., Piasecki, M.M., Rasmussen-Hall, M.L., & Palm, K.M. (2004). Acceptance-based treatment for smoking cessation. *Behavior Therapy, 35,* 689-705.

Goldberg, D.P. (1978). *Manual of the General Health Questionnaire.* Windsor: nfer-Nelson.

Gormally, J., Black, S., Datson, S. & Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addictive Behaviors, 7,* 47-55.

Hayes, S.C., Luoma, J.B., Bond, F.W., Masuda, A. & Lillis, J. (2006). Acceptance and Commitment Therapy: Model processes and outcomes. *Behaviour Research and Therapy, 44,* 1-25.

Hayes, S.C., Masuda, A., Bissett, R., Luoma, J. & Guerrero, L.F. (2004). DBT, FAP, and ACT: How empirically oriented are the new behaviour therapy technologies? Behavior Therapy, 35, 35-54.

Hayes, S.C. & Smith, S. (2005). *Get Out of Your Mind and Into Your Life.* Oakland CA: New Harbinger Publications.

Hayes, S.C., Strosahl, K.D. & Wilson, K.G. (1999). *Acceptance and Commitment Therapy. An Experiential Approach to Behavior Change.* New York: Guildford Press.

Hayes, S.C., Wilson, K.G., Gifford, E.V., Bissett, R., Piasecki, M., Batten, S.V., Byrd, M. & Gregg, J. (2004). A preliminary trial of Twelve-Step Facilitation and Acceptance and Commitment Therapy with polysubstance-abusing methadone-maintained opiate addicts. *Behavior Therapy, 35,* 667-688.

Hays, N.P., Bathalon, G.P., McCrory, M.A., Roubenoff, R., Lipman, R. & Roberts, S.B. (2002). Eating behaviour correlates of adult weight gain and obesity in healthy women aged 55-65 years. *American Journal of Clinical Nutrition, 75,* 476-483.

Hill, A.J., Weaver, C.F.L. & Blundell, J.E. (1991). Food craving, dietary restraint and mood. *Appetite, 17,* 187-197.

House of Commons Health Committee. (2004). *Obesity. Third Report of Session 2003-2004. Volume 1.* London: The Stationery Office Limited.

Jeffery, R. W., Epstein, L. H., Wilson, G. T., Drewnowski, A., Stunkard, A. J., Wilson, G. T. & Wing, R. R. (2000). Long-term maintenance of weight loss: current status. *Health Psychology, 19,* 5-16 (Suppl.).

Kayman, S., Bruvold, W. & Stern, J. S. (1990). Maintenance and relapse after weight loss in women: behavioral aspects. *American Journal of Clinical Nutrition, 52,* 800-807.

Kramer, F. M., Jeffery, R. W., Forster, J. L. & Snell, M. K. (1989). Long-term follow-up of behavioural treatment for obesity: patterns of weight regain among men and women. *International Journal of Obesity, 13,* 123-136.

Masheb, R.M. & Grilo, C.M. (2006). Emotional overeating and its associations with eating disorder psychopathology among overweight patients with binge eating disorder. *International Journal of Eating Disorders, 39,* 141-146.

McGuire, J. G., Wing, R. R., Klem, M. L., Lang, W. & Hill, J. O. (1999). What predicts weight regain in a group of successful weight losers? *Journal of Consulting and Clinical Psychology, 67,* 177-185.

Metzler, C. W., Biglan, A., Noell, J., Ary, D. V. & Ochs, L. (2000). A randomised controlled trial of a behavioural intervention to reduce high-risk sexual behaviour among adolescents in STD clinics. *Behavior Therapy, 31,* 27-54.

Must, A., Spadano, J., Coakley, E. H., Field, A. E., Colditz, G. & Dietz, W. H. (1999). The disease burden associated with overweight and obesity. *Journal of the American Medical Association, 282,* 1523-1529.

Nauta, H., Hosers, H. & Jansen, A. (2001). One-year follow-up effects of two obesity treatments on psychological well-being and weight. *British Journal of Health Psychology, 6,* 271-284.

National Heart, Lung and Blood Institute. (1998). *Clinical Guidelines on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults. The Evidence Report.* Bethesda, Maryland: National Institutes of Health.

Ogden, J. & Wardle, J. (1991). Cognitive and emotional responses to food. *International Journal of Eating Disorders, 10,* 297-311.

Pocock, S. J. (1983). *Clinical Trials. A Practical Approach.* Chichester: John Wiley & Sons.

Rapoport, L., Clark, M. & Wardle, J. (2000). Evaluation of a modified cognitive-behavioural programme for weight management. *International Journal of Obesity, 24,* 1726-1737.

Smith, B.J., Marshall, A.L. & Huang, N. (2005). Screening for physical activity in family practice. Evaluation of two brief assessment tools. *American Journal of Preventive Medicine, 29,* 256-264.

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

Tanofsky, M. B., Wilfey, D. E., Spurrell, E. B., Welch, R. & Brownell, K. D. (1997). Comparison of men and women with binge eating disorder. *International Journal of Eating Disorders 21,* 49-54.

Tapper, K., Shaw, C., Ilsley, J. & Moore, L. (2007). *Development and piloting of an acceptance based intervention for overweight and obese women.* Unpublished report.

Teasdale, J.D., Segal, Z.V., Williams, J.M.G., Ridgeway, V.A., Soulsby, J.M. & Lau, M.A. (2000). Prevention of relapse/recurrence in major depression by Mindfulness-Based Cognitive Therapy. *Journal of Consulting and Clinical Psychology, 68,* 615-623.

Tice, D. M. & Bratslavsky, E. (2000). Giving in to feel good: the place of emotion regulation in the context of general self-control. *Psychological Inquiry, 11,* 149-159.

Van Strien, T., Frijters, J. E. R., Bergers, G. P. A. & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of emotional, external and restrained eating behaviour. *International Journal of Eating Disorders, 5,* 295-315.

Van Strien, T., Schippers, G. M. & Cox, W. M. (1995). On the relationship between emotional and external eating behaviour. *Addictive Behaviors, 20,* 585-594.

Verplanken, B. (2005). Habits and implementation intentions. In: J. Kerr, R. Weitkunat, & M. Moretti (Eds.). *The ABC of Behavioural Change*. Oxford, UK: Elsevier Science (pp.99-109).

Wardle, J. (1987). Eating style a validation study of the Dutch Eating Behavior Questionnaire in normal subjects and women with eating disorders. *Journal of Psychosomatic Research, 31,* 161-169.

Wardle, J., Marshland, L., Sheikh, Y., Quinn, M., Fedoroff, I. & Ogden, J. (1992). Eating style and eating behaviour in adolescents. *Appetite, 18,* 167-183.

World Health Organisation. (2003). *Obesity and overweight.* Retrieved September 24, 2007, from http://www.who.int/hpr/NHP/docs/gs_obesity.pdf

Table 1.

Comparison of baseline characteristics across intervention and control groups.

Characteristic	Intervention	Control	p value
BMI (mean, SD)	31.8 (5.61)	31.3 (6.57)	0.75 [a]
Age (mean, SD)	43.9 (13.80)	37.6 (12.60)	0.07 [a]
Level of education (median, inter-quartile range)	1.00 (1.00–2.00)	1.00 (1.00-3.00)	0.80 [b]
Medical condition affecting weight (%)	3.2	6.5	0.55 [c]
Attending formal slimming club (%)	32.3	25.8	0.58 [c]
Age started dieting (mean, SD)	25.3 (10.98)	20.4 (6.23)	0.03 [a]*
Number of previous diet attempts (median, inter-quartile range)	6.00 (2.00-20.00)	4.00 (0.00-15.00)	0.46 [b]
Length on current diet in weeks (median, inter-quartile range)	4.00 (2.00-6.50)	5.00 (3.00-21.00)	0.25 [b]

Note. Non-parametric tests were employed where Kolmogorov-Smirnov tests indicated significantly non-normal distributions.

[a] t-test

[b] Mann Whitney U

[c] Chi Square

*$p < .05$

Table 2.
Intervention components

Component	Aims	Key metaphors and exercises	Application to weight loss
Workshop 1			
Values	• To identify personal values. • To determine whether weight loss would support such values.	• Imaginary reminiscence exercise • Personal values questionnaire • Values assessment rating	• Enhance motivation to lose weight
Cognitive defusion	• To learn to see thoughts as just thoughts rather than ideas that necessarily need to be believed and acted upon.	• Mind bus metaphor • Triggers and responses diary • Leaves on a stream exercise • Thought distancing techniques	• To become aware of when thoughts may sabotage diet and exercise plans. • To help break links between diet / food-related thoughts and behaviour.
Workshop 2			
Control	• To become aware that attempting to control feelings and bodily sensations may not always be successful.	• Shark tank metaphor • Child in a supermarket metaphor	• To become aware that eating to control or avoid negative emotions will not help in the long term. • To become aware that relying on diet strategies to completely alleviate feelings of hunger and cravings may be unrealistic.
Acceptance / willingness	• To learn to embrace rather than avoid internal discomfort as an alternative strategy to control.	• Tug of war metaphor • Food triggers and responses diary • Giving your feelings a form exercise • Tin Can monster exercise • Exposure exercise	• To help the individual tolerate negative emotions (including diet-related feelings such as hunger or cravings) rather than rely solely on control or avoidance strategies.

Table 2 continued

Self awareness / mindfulness	• To develop a sense of self that can enable thoughts and feelings to flow without attachment. • To enable the individual to stay in non judgemental contact with psychological and environmental events as they occur.	• Observational self exercise • Daily self awareness exercises • Be where you are exercise	• To aid defusion and acceptance strategies detailed above.
Workshop 3			
Committed action	• To become aware of the importance of committing to values. • To identify goals consistent with the individual's values.	• Soap bubble metaphor • Mountain path metaphor • Goals, barriers and actions exercise • Living in accordance with values exercise	• To help the individual set and achieve weight loss goals. • To encourage adherence to weight loss / maintenance strategies over the long term.
Workshop 4			
Review	• To review participants' experience over the intervening months and help clarify any difficulties they may have had. • To remind participants of key concepts and strategies.	• Question and answer session • Selection of exercises and metaphors from previous workshops	• As above

Table 3.

Comparison of questionnaire measures across intervention and control groups at baseline[a]

Measure (scale)	Intervention	Control	p value [b]
Brief physical assessment tool (0-16)	5.3 (4.20)	7.3 (3.70)	0.046*
GHQ-12 (0-36)	12.8 (4.62)	13.2 (5.32)	0.761
External eating (DEBQ) (1-5)	3.2 (0.53)	3.4 (0.42)	0.059
Emotional eating (DEBQ) (1-5)	3.3 (0.77)	3.5 (0.64)	0.331
Emotional eating (EEQ) (0-7)	1.4 (0.88)	1.4 (0.72)	0.916
Binge eating scale (0-18)	9.1 (3.48)	7.2 (3.89)	0.047*
AAQ-II (10-70)	46.4 (9.52)	43.2 (11.04)	0.224
Adherence to weight loss strategies over previous week (0-4)	2.00 (1.00-3.00) [c]	2.00 (1.00-3.00) [c]	0.467 [d]

[a] Values are means (SDs) unless otherwise stated.

[b] Values are based on t-tests unless otherwise stated.

[c] Median and inter-quartile range

[d] Mann Whitney U test

* $p < .05$

Table 4.

Mean change scores (and SDs) and effect sizes for outcome variables for the intention-to-treat and intervention efficacy analyses.

	Intention to treat			Intervention efficacy		
Outcome measure	**Intervention (n=31)**	**Control (n=31)**	**Effect size**	**Intervention (n=23)**	**Control (n=24, 23, 24)**	**Effect size**
BMI	-0.31 (1.57)	+0.11 (1.00)	0.16 (0.54kg)	-0.54 (1.49)	-0.04 (0.91)	0.20 (1.35kg)
Physical activity	+1.66 (4.28)	-0.74 (2.91)	*0.31 (2.4 sessions per week)	+2.20 (4.35)	-0.61 (3.34)	*0.34 (2.8 sessions per week)
Mental health difficulties	-1.05 (7.46)	+0.91 (6.07)	0.14	-1.08 (8.50)	+0.88 (6.91)	0.13

*p < .05

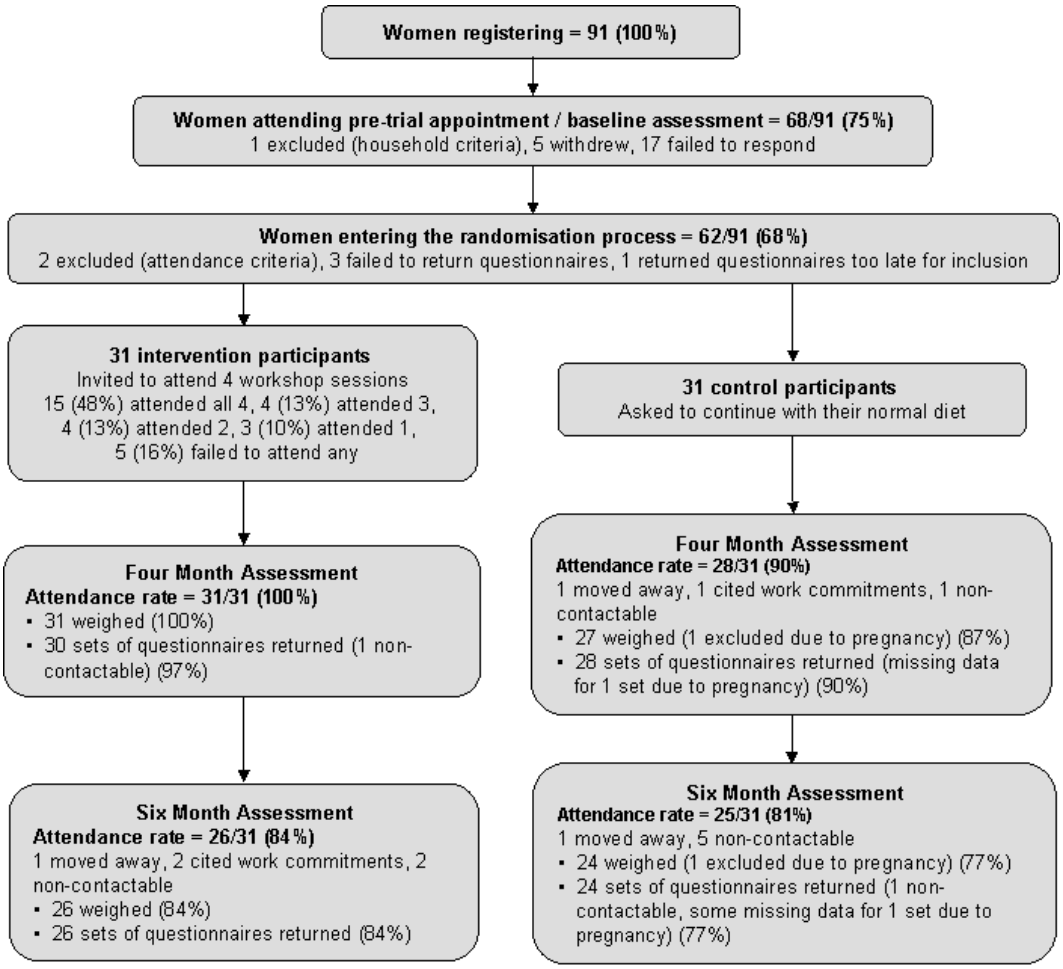
Table 5.

Comparison of mean change scores (and SDs) across intervention and control groups for each of the six mediator variables.

Measure	Intervention	Control	F and t values
External eating (DEBQ)	-0.06 (0.59) (n=23)	-0.19 (0.39) (n=23)	F = 0.78
Emotional eating (DEBQ)	-0.28 (0.53) (n=23)	-0.18 (0.68) (n=23)	F = 0.27
Emotional eating (EEQ)	-0.30 (0.94) (n=23)	+0.13 (1.38) (n=23)	F = 2.24
Binge eating	-1.70 (3.87) (n=23)	+0.57 (3.37) (n=23)	F = 4.47*
Acceptance and action (AAQ)	+0.27 (0.75) (n=24)	+0.19 (1.02) (n=24)	t = 0.31
Diet adherence	+0.32 (1.29) (n=22)	-0.35 (1.47) (n=23)	t = 1.62

*$p < .05$

Figure 1. Flow of participants through the study.


Women registering = 91 (100%)
Women attending pre-trial appointment / baseline assessment = 68/91 (75%)
1 excluded (household criteria), 5 withdrew, 17 failed to respond
Women entering the randomisation process = 62/91 (68%)
2 excluded (attendance criteria), 3 failed to return questionnaires, 1 returned questionnaires too late for inclusion
31 intervention participants
Invited to attend 4 workshop sessions
15 (48%) attended all 4, 4 (13%) attended 3,
4 (13%) attended 2, 3 (10%) attended 1,
5 (16%) failed to attend any
31 control participants
Asked to continue with their normal diet
Four Month Assessment
Attendance rate = 31/31 (100%)
• 31 weighed (100%)
• 30 sets of questionnaires returned (1 non-contactable) (97%)
Four Month Assessment
Attendance rate = 28/31 (90%)
1 moved away, 1 cited work commitments, 1 non-contactable
• 27 weighed (1 excluded due to pregnancy) (87%)
• 28 sets of questionnaires returned (missing data for 1 set due to pregnancy) (90%)
Six Month Assessment
Attendance rate = 26/31 (84%)
1 moved away, 2 cited work commitments, 2 non-contactable
• 26 weighed (84%)
• 26 sets of questionnaires returned (84%)
Six Month Assessment
Attendance rate = 25/31 (81%)
1 moved away, 5 non-contactable
• 24 weighed (1 excluded due to pregnancy) (77%)
• 24 sets of questionnaires returned (1 non-contactable, some missing data for 1 set due to pregnancy) (77%)