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Developing Self-Regulation for Dietary Temptations: Intervention Effects on Physical, Self-Regulatory and Psychological Outcomes.

Abstract

We aimed to investigate whether a self-regulatory skills intervention can improve weight loss-related outcomes. Fifty five participants (M_{BMI} = 32.60±4.86) were randomized into experimental and control groups and received two training workshops and weekly practice tasks. The experimental group was trained to use six self-regulatory skills: Delayed gratification, thought control, goal setting, self-monitoring, mindfulness, and coping. The control group received dietary and physical activity advice for weight loss. Physical, self-regulatory, and psychological measures were taken at baseline, end of intervention (week 8) and at follow-up (week 12). Using intention-to-treat analysis, weight, waist circumference, body fat and body mass index (BMI) were significantly reduced at follow-up for both groups. There were significant increases in all six self-regulatory skills and the psychological measures of self-efficacy, self-regulatory success, and physical self-worth for both groups. Results indicate that self-regulatory skills training might be as effective as dietary and physical activity advice in terms of weight loss and related outcomes.

Keywords: Self-control, self-regulation, weight loss, self-efficacy, diet, physical activity

There is a large body of evidence that supports dietary and physical activity interventions as a means to produce small to modest reductions in weight loss (around 5-10%; Jeffrey et al., 2000; Wing, 1998). Yet, the majority of people fail to maintain the positive dietary and physical activity habits adopted beyond the prescribed intervention period (Sharma, 2007; Shaw, O'Rourke, Del Mar, & Kenardy, 2005). Therefore, knowledge of the best behavior change methods alone is insufficient for weight regulation success.

Researchers have called for a focus on the psychological factors that lead to weight loss and weight maintenance success (Byrne, Cooper, & Fairburn, 2003). One particularly salient factor is self-control/self-regulation. This is defined as an individual's ability to override or inhibit behaviors, urges, emotions, or desires that would otherwise hinder goal-directed behavior (Baumeister & Vohs, 2007). Recent calls have been made for research that investigates the self-regulatory skills that facilitate an individual's ability to resist temptation (Carels et al., 2004; Johnson et al., 2012). To this end, the current study aims to examine how training one's self-regulatory skills relates to improvements in the frequency of use of these skills, weight loss, and associated physical and psychological outcomes, compared to an intervention providing information on best dietary and physical activity practices.

In this study a broad self-regulatory approach was taken that incorporated a number of self-regulatory skills as it was felt that one conceptual framework would not be comprehensive enough to cover the various skills associated with successful management of dietary temptation. The ability to *delay gratification* has been identified as a key self-regulatory strategy or skill that taps the processes necessary for effective impulse control and for sustaining self-control strength when faced with strong temptation (Metcalfe & Mischel, 1999). Another important self-regulatory skill is *thought control*. This is particularly important in social situations where food is available, as the presence of others can increase susceptibility to lapse (Carels et al., 2004; Wansink, 2006). A fundamental aspect of self-regulatory behavior is the ability to develop *goal setting* skills (Carver, 2004; de Ridder & de Wit, 2006). A recent review investigating the use of goal setting as a self-regulatory skill in overweight and obese adults concluded that goal setting is a promising, cost-saving and potentially empowering skill that can be relatively easily incorporated into most community-

orientated weight loss interventions (Pearson, 2012). Closely related to goal setting behavior is the *self-monitoring* of one's goals. The ability to self-monitor is a key element in developing successful self-regulation (Carver, 2004; de Ridder & de Wit, 2006). Another skill that may increase one's awareness of temptation is *mindfulness*. Mindfulness is created by focusing on body signals as well as sensory experiences, thoughts, and emotions (Brown & Ryan, 2003). Research demonstrates that the development of mindfulness skills can enhance self-control strength (Masicampo & Baumeister, 2007). Further, Dohm, Beattie, Aibel, & Striegel-Moore (2001) have shown that those who are unsuccessful at maintaining weight loss tend to have a poor range of *coping skills*. Dohm and colleagues (2001) found that the key difference between weight maintenance success and failure was an individual's response to lapse, and that helping individuals develop adaptive coping responses (e.g., treating lapse as a small mistake) through skills training could be the most effective preparation skill to help people maintain their weight loss (Dohm et al., 2001).

The present study also attempts to address two problems. First, previous research has shown that the use of self-regulatory skills has been associated with improved weight loss in interventions (Annesi & Gorjala, 2010; O'Neil et al., 2012). However, these interventions tended to incorporate physical activity and dietary advice alongside their self-regulatory skills training. Therefore, it is difficult to isolate the independent effect of training self-regulatory skills. The second problem is that although they are often associated with positive behavior change, many weight loss interventions are overly expensive and complex (Franz et al., 2007; Lombard, Deeks, Jolley, Ball, & Teede, 2010). The majority of community-based weight loss programs are limited by time and resources, therefore, intensive research interventions are not always feasible in terms of their ability to be rolled out to primary care and community samples (Economos & Irish-Hauser, 2007; Fabricatore et al., 2008). Hence, there have been calls for interventions that are of lower intensity and cost, which are easily deliverable and applicable to a diverse range of individuals in the community (e.g., Lombard et al., 2009).

In conclusion, the current study is unique in that it combines a number of temptation-related self-regulatory skills in a low intensity intervention. Furthermore, it addresses an important gap in the literature by investigating the effects of training these self-regulatory

skills on weight-related outcomes independently of dietary or physical activity advice. We hypothesized that participants who received training in these skills (the experimental group) would demonstrate greater changes over a period of 12 weeks in the frequency of use of those skills relative to those in the control group who would receive information on the best dietary and physical activity practices for weight loss. We also expected that those in the experimental group would experience similar positive changes to the control group in physical outcomes [weight loss, lower waist circumference, body fat, body mass index (BMI)] physical activity levels, and psychological (higher self-efficacy, perceived self-regulatory success, and physical self-worth) outcomes over time.

Method

Participants and Procedure

We analyzed data from 55 participants (M_{age} = 37.60 years, *SD*= 13.47, M_{BMI} = 32.60, *SD* = 4.86, 72% female). Based on objectively assessed BMI, participants were classified as obese (62%), overweight (35%), or morbidly obese (3%). Participants were selected if they currently held a weight loss goal, if they were overweight (a BMI > 25) and had no health conditions that required medical supervision of diet or exercise. For those in employment, they were asked to specify their work department and those in the same department were allocated to the same group to avoid contamination between groups. Thus, our study was more of a 'pragmatic randomization' which is appropriate to the real life circumstances in which the intervention operated (Hotopf, 2002). As a result, our intervention followed the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) protocol (Des Jarlais, Lyles, & Crepaz, 2004). Ethical approval for the study was granted by a British University ethics committee. The experimental condition (*n* = 27) involved the development of six key self-regulatory skills. No advice was given about physical activity or dietary choices. The control condition (*n* = 28) was based on evidence of the best dietary and physical activity choices for weight loss and weight maintenance (Sharma, 2007; Shaw, Gennat, O'Rourke, & Del Mar, 2006). No advice was given about

self-regulatory skills. Details of the experimental and control group workshops and the weekly practice tasks sent via email are provided in the online supplementary material.

Measures

Participants' weight, waist, body fat, self-regulatory skills, and responses to physical activity and psychological measures were assessed at baseline, end of intervention (week 8), and follow-up (week 12). As a fidelity check, participants were asked to rate the extent to which they adhered to their own weight loss practices during the intervention and the extent to which they applied the intervention principals. These two items were rated from 1 (*never*), to 5 (*all of the time*) at the end of the intervention. Descriptive statistics for all baseline, end of intervention, and follow-up variables are presented in Table 1. Details for all physical, self-regulatory and psychological measures are provided in the online supplementary file.

Results

Retention and Treatment

We powered on weight loss as this was the variable for which we had the most available information from past literature. Based on previous estimates (e.g., Forman et al., 2009), a small-to-medium effect size was expected (partial eta squared = 0.03). Hence, for a two-tailed analysis for three time points over which the data were collected, we calculated that a total sample size of 36 was necessary to detect this effect size. However, based on the attrition rates of similar past weight loss research (Forman et al., 2009), and cognisant of literature specifically examining attrition rates in weight loss interventions (Honas et al., 2003; Teixeira et al., 2004), we built into our sample size calculations an extra 35%. Of the 55 participants eligible for analysis, 32 participants completed the entire 12 weeks. Given the 34% attrition, analyses are presented as intention-to-treat (ITT) including all 55 participants, carrying forward the last observation. The unit of analysis was the individual. No blocking was used. Figure 1 displays the flow of participants throughout the study.

Main Analyses

Three doubly MANCOVAs were employed to analyze the changes in physical, self-regulatory and psychological measures, respectively. We chose multivariate analyses as opposed to univariate tests to control for Type I error. Physical activity could not be grouped with any of the other variables and therefore it was analyzed with a separate ANCOVA. We also report separate ANCOVAs for all measures in an online supplementary file. In all analyses we controlled for sex and number of previous weight loss attempts. The number of previous weight loss attempts was included as a covariate as it is thought to be one of the most consistent predictors of poor weight loss success and drop-out in intervention studies (Kiernan, King, Kraemer, Stefanick, & Killen, 1998; Teixeira et al., 2004). Each doubly MANCOVA had time (baseline, week 8, week 12) as the within-subject factor and group (experimental vs. control) as the between-subject factor. F and p values, as well as effect sizes for all variables are reported in the online supplementary material.

Physical measures. Both groups experienced significant decreases over time in weight (kg), waist circumference (cm), body fat (%), and BMI $\Lambda = .52$, F (8,35) = 4.74, $p = .000$ ($\eta^2_p = .52$). However, no significant group or interaction effects were observed.

Physical activity. No significant differences in physical activity were found for time, group or interaction effects for both groups.

Self-regulatory skills. Significant improvements over time were found for both groups for all the self-regulatory skills measured $\Lambda = .47$, F (12,35) = 3.31, $p = .00$ ($\eta^2_p = .53$). There was a significant group x time interaction effect found with the experimental group experiencing a significantly greater increase in the frequency of use of the self-regulatory skills over time $\Lambda = .54$, F (12,35) = 2.46, $p = .01$ ($\eta^2_p = .45$).

Psychological measures. A significant main effect for time was found in both groups for self-efficacy, perceived self-regulatory success, and physical self-worth ($\Lambda = .52$, F (6,39) = 3.22, $p = .01$ ($\eta^2_p = .33$). No other main or interaction effects were found.

Protocol analysis using complete cases only demonstrated similar findings for all outcomes (Piaggio, Elbourne, Altman, Pocock, & Evans, 2006).

Discussion

This is one of the first interventions to examine whether a diverse group of temptation-related self-regulatory skills can be trained in order to facilitate (independent of physical activity and dietary advice) weight loss and associated physical and psychological outcomes. Results indicated that this minimal cost and pragmatic intervention can be as effective as physical activity and dietary advice in producing changes in physical, self-regulatory and psychological outcomes. Although some significant group by time interactions emerged in univariate analyses, indicating greater improvements in the experimental group (the results are shown in an online supplementary file), we focused our interpretation on significant multivariate effects to reduce the risk for Type I error. The majority of effect sizes both at the multivariate and univariate levels were medium to large (based on the cut off values for eta squared of 0.01 = small, 0.06 = medium, and 0.14 = large; Cohen, 1988).

Physical Measures and Physical Activity

Both the experimental and control groups had significant reductions in weight, waist circumference, body fat, and BMI over time. The control group lost on average 1.76kg. A review of psychological interventions for weight loss has found that changes in the wait list and advice-only control groups vary from -1.8kg weight loss to 1.8kg weight gain over a 12 month period (Shaw, O'Rourke, Del Mar, & Kenardy, 2005). Given that there is substantial evidence showing the effectiveness of dietary and exercise behaviors in producing small to moderate effects on weight loss (Sharma, 2007), it is positive to note that for the experimental group training specific self-regulatory skills alone (without encouraging specific dietary and physical activity practices) produced similar short-term weight-related improvements. We found that the experimental group had a 2.85% weight loss over 12 weeks. If this weight loss was to continue at a similar rate over a 6 month period, it would be expected to be greater than 5%, which is deemed by some (e.g., Donnelly, Blair, Jakcic, Mannae, Rankin, & Smith, 2010) as clinically meaningful. Although trends in the data indicated increases in physical activity over time, there were no significant differences in physical activity in both groups. This was unexpected, as promoting physical activity was a focus of the intervention in the control group. The exceptionally poor weather for the UK

experienced during the months that the study took place may have deterred the control group from exercising as much as hoped. Indeed studies have shown seasonal/weather effects to hamper physical activity (Tucker & Gilliland, 2007).

Self-Regulatory Skills

Both groups experienced significant increases in the frequency of the six self-regulatory skills over time. However, there was a significant time x group interaction effect found showing greater frequency of use of the self-regulatory skills over time in the experimental group. This greater increase in the experimental group was expected given that the training in this group focused on improving these skills. However, the increase in all six self-regulatory skills in the control group was unexpected. As previously illustrated by Oaten and Cheng (2006), practice in one area of self-control (e.g., physical activity) can lead to improvements on a number of other self-regulatory behaviors, and this may explain why the control group also experienced increases in the six intervention skills. Additionally, given that the average number of weight loss attempts per participant was 6.08, it may have been that those in the control group had previously been taught some the self-regulatory skills practiced by the experimental group. Nevertheless, as noted earlier, there was a greater increase in the use of these skills in the experimental group. Hence, previous exposure to self-regulatory training, although to a large effect unavoidable due to the pragmatic nature of our intervention (it would have been very difficult to recruit overweight participants with no previous weight loss attempts), did not compromise the integrity of our study.

Psychological Measures

Both experimental and control groups experienced significant increases in all psychological outcomes assessed. First, both groups had comparable significant increases in self-efficacy for appropriate eating. The significant increases in self-efficacy in the experimental group may be due to the self-regulatory skills trained in the intervention. Indeed, research investigating the self-efficacy of eating behaviors has found that as self-regulatory skills increase, perceived self-efficacy in relation to eating behavior can also

increase (Annesi & Gorjala, 2010). The increases in the control group may be due to the specific focus on improving knowledge of the best dietary methods for weight loss success; dietary interventions have been known to be associated with improving self-efficacy for appropriate eating (Clark, Abrams, Niaura, & Eaton, 1991). Second, both groups also reported increases in perceived self-regulatory success. In view of the significant decreases in weight, waist circumference, body fat, and BMI, it is unsurprising that both groups experienced increases in their perceptions of success at weight loss. Third, both groups experienced significant increases in physical self-worth. Research has shown that weight loss and weight maintenance are associated with increased self-worth (Elfhag & Rössner, 2005). As both groups had relatively similar levels of weight loss, it is perhaps unsurprising that they also experienced similar increases in physical self-worth.

Limitations, Future Directions, and Conclusions

The current study was subject to a few limitations. First, the substantial attrition (34%) may limit the ability to draw firm conclusions. Yet, the current study's attrition of 34% is well within the range of that found by related research (Forman et al., 2009; Honas et al., 2003; Teixeira et al., 2004). Additionally, a follow-up period of four weeks is relatively short in comparison to other weight loss interventions which tended to have follow-up periods of 6 to 12 months (for examples, see Gourlan et al., 2011; Lombard et al., 2009). Yet, weight loss is a complex process and many people experience frequent changes in their persistence, effort, and commitment. The current study's low intensity, low cost approach (which required a minimal commitment of attendance of two workshop sessions and regular involvement via email practice tasks) may have the potential to be more accessible to and accepted by a wide range of individuals in the community. Given the rising financial burden of obesity on the already strained national health service in the UK (estimated at £5.1bn per year; Scarborough et al., 2011), future research could investigate the economic costs of running both the experimental and control interventions. In summary, our results provide initial evidence to suggest that helping people improve temptation-related self-regulatory skills may be just as important as helping them change their physical activity and dietary behaviors.

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Table 1

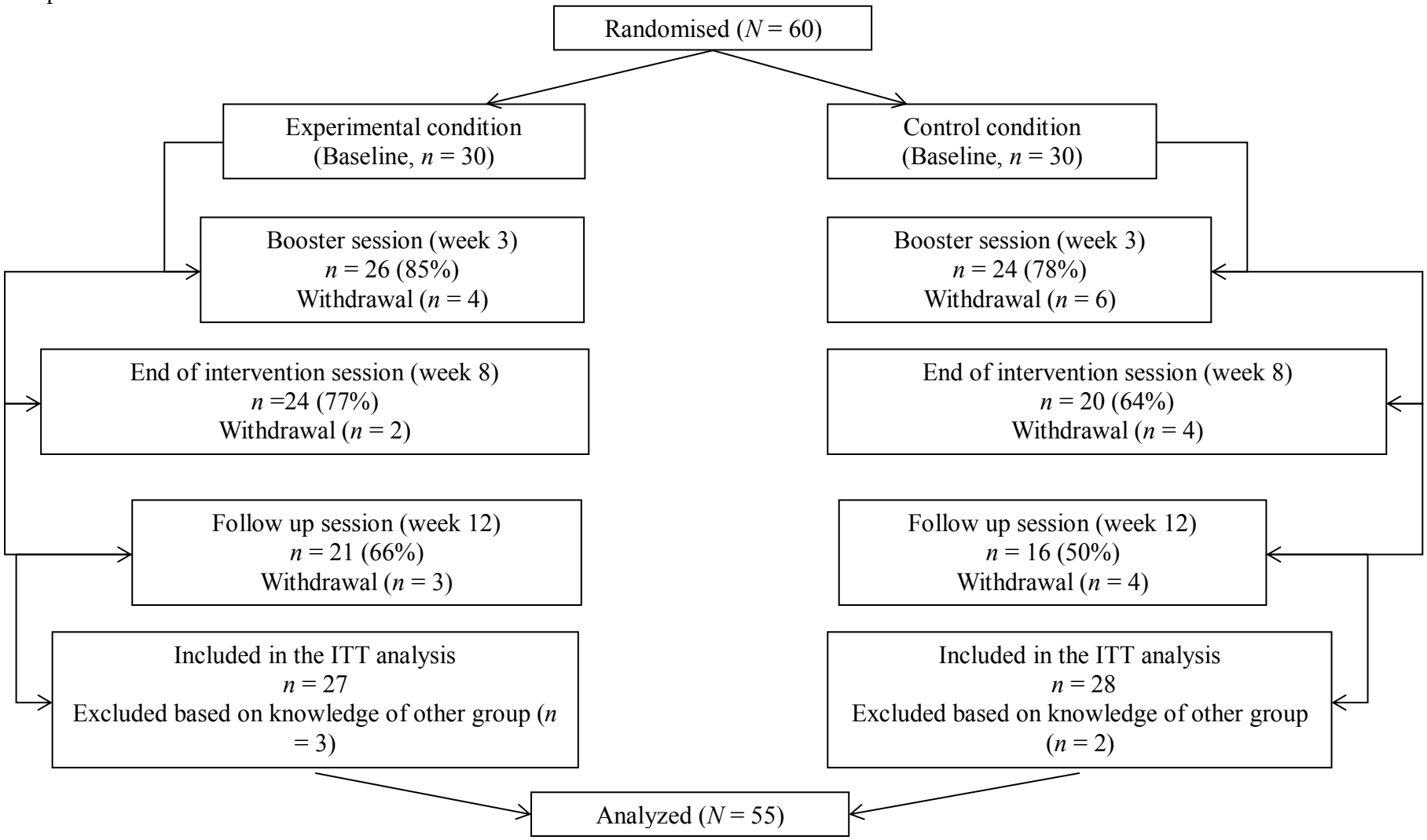
Descriptive Statistics for the Physical, Self-Regulatory, and Psychological Measures at Baseline, End of Intervention, and Follow-up

Variable	Baseline *M* (*SD*)		End of intervention (week 8)		Follow-up (week 12)	
	Experimental	Control	Experimental	Control	Experimental	Control
Physical measures						
Weight (kg)	88.02 (13.68)	87.97 (13.07)	85.71 (14.02)	86.52 (12.49)	85.52 (13.67)	86.21 (12.65)
Waist (cm)	101.56 (10.84)	103.64 (11.11)	97.32 (11.84)	100.06 (12.22)	96.31(12.92)	99.29 (11.79)
Body fat (%)	37.56 (8.27)	40.69 (8.31)	36.97 (8.76)	40.05 (8.62)	36.85 (8.96)	39.40 (8.94)
BMI	31.58 (4.38)	32.96 (4.13)	30.80 (4.57)	32.46 (3.72)	30.73 (4.43)	32.35 (3.84)
Physical activity						
	1420.24 (1127.67)	1370.46 (1577.08)	1852.98 (1771.67)	2915.30 (2756.38)	2490.32 (2621.98)	3011.65 (2759.88)
Self-regulatory skills						
Delayed gratification	1.02 (1.20)	1.12 (1.47)	2.32 (1.47)	1.54 (1.51)	2.55 (1.45)	1.47 (1.37)
Thought control	.88 (1.21)	1.41 (1.63)	2.23 (1.47)	1.50 (1.53)	2.58 (1.50)	1.46 (1.53)
Goal setting	.92 (1.12)	.91 (1.16)	1.50 (1.13)	1.08 (1.11)	1.65 (1.31)	1.08 (1.12)
Self-monitoring	2.03 (1.70)	1.46 (1.45)	2.63 (1.62)	1.88 (1.41)	2.67 (1.58)	1.67 (1.40)
Mindfulness	2.50 (1.41)	2.02 (1.55)	3.02 (1.16)	2.52 (1.65)	3.09 (1.15)	2.78 (1.71)
Coping	.85 (1.14)	.81 (1.20)	2.02 (1.53)	1.67 (1.49)	2.07 (1.57)	1.54 (1.55)
Psychological measures						
Self-efficacy	90.88 (40.49)	104.81 (41.67)	101.95 (45.23)	108.76 (46.68)	109.62 (46.23)	111.46 (49.90)
Self-regulatory success	7.08 (2.66)	8.46 (3.59)	8.56 (3.7)	8.23 (3.50)	9.08 (3.80)	8.61 (3.55)
Physical self-worth	1.92 (0.73)	2.12 (0.90)	2.13 (0.78)	2.13 (0.94)	2.21 (0.87)	2.25 (0.98)

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1.

Participant Randomization and Retention Flow Chart



Online supplementary file:

Method

Participants

The sample included 60 participants. Five participants were removed from the analyses on suspicion of potential contamination of intervention treatment. Participants were White (54%), South Asian (Indian, Pakistani and Bangladeshi; 24%), Black (13%), Chinese (6%), or of other ethnic origin (3%). The majority of the sample was in full-time employment (42%); the remaining were primarily students (36%). The most frequently reported highest qualification was university honors degree (43%). The average number of previous attempts at weight loss per participant was 6.08 (SD = 8.20).

Procedure

Participants were recruited via an email bulletin sent to university hospital staff and non-academic university staff, students, and community members. The duration of recruitment was one month. The procedure and measures for both the experimental and control groups were piloted in a separate group of dieters (n = 11). The purpose of the pilot was to test if the participants understood the content of the intervention and the instructions for practicing the self-regulatory skills. Based on feedback from the pilot, the content of the workshops was modified by increasing the amount of interactive tasks and decreasing the reliance on audiovisual presentation slides. Both groups completed nearly identical study protocols, the only difference being the content of the interventions. Both groups participated in a 3-hour workshop at baseline outlining the principals of the intervention and a 1.5-hour booster session (week 3) recapping the key intervention components. These workshops took place in a seminar room within a university. The workshops were supplemented by weekly practice tasks sent via email throughout the 8 weeks of the intervention. A considerable focus of the baseline and booster workshops was to encourage the practice of these tasks at home.

The workshops for both groups were deliberately low in intensity requiring equal or less contact hours with the participants than in other weight loss studies which were labeled as 'low intensity' (Iqbal et al., 2010; Lombard et al., 2010; Shaw et al., 2005). All workshops were conducted by the lead researcher and data were collected by research assistants who were unaware of the study's hypotheses. The workshops incorporated different methodologies to adapt to participants' different levels of learning (e.g., audiovisual presentation, group discussions, individual and interactive tasks). In order to independently assess the key strategies of the intervention, the experimental group did not receive any specific advice on diet or exercise practices; equally, the control group did not receive any specific information on the six self-regulatory strategies. To ensure contamination did not occur, all participants were asked "Have you gained/asked for any information about the other weight loss group running simultaneously to yours?" (Rated from 1, *none,* to 5, *a lot).* The majority of the sample did not receive any information from the other weight loss group however, three participants rated that they received *a lot* of information and two *a small amount.* Based on the criteria for exclusion in previous intention-to-treat studies, it was felt that the exclusion of these five individuals from subsequent analyses was justified (Abraha & Montedori, 2010; Gupta, 2011).

Measures

Physical measures. Height was measured at baseline using the Leicester Height Measure (SMSSE-0260). Weight (kg) and body fat (%) were measured using a recently calibrated bioelectrical impedance Tanita Scale (SC-331s) with the participant in light clothing, without footwear or socks (participants were instructed to wear the same clothing at each measurement session). Weight loss was calculated as the change in kilograms from baseline to follow-up (week 12). Participants waist circumference was measured at the

narrowest part of the torso between the iliac crest and the xiphoid process (ACSM; 2009). Waist circumference was measured to the nearest 0.1cm.

Physical Activity.

Physical activity completed over a week was measured using the short version of the International Physical Activity Questionnaire (Booth, 2000).

International Physical Activity Questionnaire (IPAQ). The questionnaire contained six items measuring the duration and frequency of vigorous and moderate exercise, as well as walking behavior (e.g., "During the last 7 days, on how many days did you walk for at least 10 minutes at a time"?, and "how much time did you usually spend walking on one of those days?"). The total physical activity score was determined by the summation of the duration (minutes) and frequency (days) scores (metabolic equivalents for activity were as follows: vigorous = 8.0, moderate = 4.0, and walking activities = 3.3). The scale scores have demonstrated adequate reliability and validity in previous research (Hallal & Victora, 2004). Cronbach's α for the IPAQ items in the current study were 0.96, 0.66, 0.67 for baseline, end of intervention, and follow-up, respectively.

Self-regulatory skills. Participants in both groups reported on the frequency of employment and perceived effectiveness of six self-regulatory skills: Delayed gratification, thought control, goal setting, self-monitoring, mindfulness, and coping. Each of the skills were assessed by two items (e.g., self-monitoring frequency; "The frequency with which you monitor your weight loss goals on a daily/weekly basis", and "The frequency with which you record some aspect of your weight loss on a regular basis"), and these two items were then summed to give average scores for frequency of employment and for effectiveness. Items were rated from 0 (*do not use*) or 1 (*not frequently used/not effective at all*), to 5 (*very frequently used/very effective*). The average intra-variable *r* across the six variables for both

frequency and effectiveness was 0.77, therefore only the findings regarding self-regulatory skill frequency are presented.

Psychological measures. Participants completed measures of self-efficacy for appropriate eating, perceived self-regulatory success in dieting, and physical self worth.

Weight Efficacy Lifestyle Scale (WELS). Self-efficacy for appropriate eating, was measured using the Weight Efficacy Lifestyle Scale (Clark, Abrams, Niaura, & Eaton, 1991). The scale is comprised of 20 items measuring five dimensions of eating self-efficacy (negative emotions, availability, social pressure, physical discomfort, and positive activities), each consisting of 4 items (e.g., availability: "I can control my eating on the weekends"). Items were rated from 0 (*not confident*) to 9 (*very confident*). All items were summed to give a total score. Previous Cronbach alphas for the five dimensions ranged from 0.70-0.90 (Clark et al., 1991); in the current study the average alphas across the five scales were 0.95, 0.95, 0.96, at each of the three time points.

Perceived Self-Regulatory Success in Dieting Scale (PSRS). Perceptions of success in weight loss were measured using the Perceived Self-Regulatory Success in Dieting Scale (Fishbach et al., 2003). Participants responded to three items indicating how successful they felt in terms of losing weight, watching their weight, and how difficult they found it to stay in shape (reverse coded). Items were rated from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores are indicative of greater success in dieting (Cronbach α = 0.96, 0.81, 0.67). The scale scores have been previously demonstrated as reliable and valid measures of dieting success (Meule, Papies, & Kübler, 2012).

Physical Self-Worth Scale (PSW). Physical self-worth was measured using five items from the revised Physical Self-Perception Profile (PSPP-R; Lindwall et al., 2011). Items were categorized into four responses, ranging from 1 (*not at all true for me*) to 4 *(really true for me*; e.g., "I am happy with how I am and what I can do physically"). Items were summed to

give a total PSW score (Cronbach α = 0.97, 0.86, 0.93, for each time point). The scale scores have previously demonstrated adequate reliability and validity (Lindwall, Asci, & Hagger, 2011).

Results

Three MANOVAs were run on the physical, self-regulatory skills, and psychological measures in order to determine if there were any differences in baseline values between those who completed assessments at all time points and those who did not; no differences were found for any of the variables ($p > 0.05$). The same was the case for physical activity which was tested via an ANOVA. A series of *t*-tests were run to examine if there were any significant differences at baseline between the experimental and control groups for all the study variables; no differences were observed ($p > 0.05$). There were also no significant differences between the groups in the extent to which participants rated that they adhered to the allocated program principals ($p = 0.89$), or to their own dietary and physical activity practices ($p = 0.30$), during the intervention. Descriptive analyses show that the number of participants with complete data who lost weight was 35 (-0.20 to -6.90 kg), with five having gained weight (1-3kg).

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Table S1

Experimental Group Workshop Content and Practice Tasks

Experimental group		
Self-regulatory skills	Workshop and booster session content	Weekly practice tasks (sent via email)
Delayed gratification	• Introduce: Concept of delayed gratification • Practice: Allocating time for treats	• Planning for delayed gratification
Thought control	• Introduce: Positive self-talk vs. negative self-talk, refusal framing, long-term goal thinking • Practice: Interactive self-talk tasks	• Refusal framing, long-term goal thinking, and positive self-talk
Goal setting	• Introduce: Guided goal setting-focusing on the importance/value of one's weight loss goal • Practice: How to set short, medium, and long-term goals, how to be realistic and specific in goal setting	• Goal prompts, visibility of goals, engaging others, re-evaluating goals (week 6), vocalization of goals, positive reminders of success so far, and visual tools
Self-monitoring	• Introduce: Self-monitoring and its links to weight loss success • Practice: Exploring different methods of self-monitoring, in particular encouraging temptation monitoring	• Reviewing self-monitoring: Learning-when, where, and why we are tempted
Mindfulness	• Introduce: Mindfulness, its origins and applications; Mindless eating and the influence of the environment on consumption • Practice: Eating-related mindfulness (savoring eating exercise) and satiety-related mindfulness (water drinking exercise)	• Consuming one meal a week with a focus on a different aspect of mindful eating: sight, smell, taste, size, pace, and satiety • Switching glasses, using smaller serving plates, limiting food exposure

Coping skills	• Introduce: Coping, including examples of passive and active coping strategies • Practice: Strategy building on how to overcome coping failure	• Self-reflection on past coping failures e.g., reassessing goals, and exercises to improve active coping during stressful periods
Control group		
Diet and exercise tips	Workshop and booster session content	Weekly practice tasks (sent via email)
Dietary tips	• Introduce: The weight loss industry, fad diets, and common misconceptions • Practice: Food labeling, identifying low fat/high sugar foods • Introduce: The dangers of high sugar/fat/salt consumption, possible alternatives, how to reduce consumption • Practice: Identifying liquid calories • Introduce: Portion awareness and control • Practice: Understanding appropriate portion sizes • Introduce: The food pyramid • Practice: Balancing the food pyramid • Introduce: Fats-good fats vs. bad fats • Introduce: Restaurant dieting traps • Practice: Choosing the healthiest restaurant options	• Cutting down sugar intake by looking for foods with less than 10g per 100g (ideally less than 5g per 100g) • Increasing protein intake-1 portion with every meal-high protein recipes to try • Food labelling check at home-throw out foods identified as high sugar/fat/salt • Switching refined carbohydrates for complex alternatives-complex carbohydrate recipes to try • Going liquid calorie free for a week • Controlling blood sugar with low GI snack recommendations
Physical activity tips	• Introduce: Exercise for weight loss • Practice: Understanding which types of exercise are best for weight loss • Introduce: The best ways to perform exercises-frequency, intensity, duration • Introduce: The danger of sedentary behavior • Practice: Tips for reducing sedentary time	• Tips for reducing sedentary time • Tips for overcoming exercise barriers e.g. time, weather • Interval exercises for beginners, intermediate, advanced • Resistance exercises for beginners, intermediate, advanced • Exercises to increase walking, running or swimming intensity • Local facilities and sports clubs sharing (overcoming barriers-accessibility)

Table S2

Results of the Doubly MANCOVA's and ANCOVA Predicting the Physical, Physical Activity, Self-regulatory, and Psychological Measures

Variable	Wilk's Lambda	*F*	*df*	*P*	Partial eta squared
Physical measures					
Time	.52	4.74	8,35	.00***	.52
Group	.87	1.50	4,39	.23	.13
Time x group	.93	.35	8,35	.94	.07
Physical Activity					
Time		2.37	2,47	.09	.05
Group		.85	1,48	.36	.02
Time x group		.68	2,47	.51	.01
Self-regulatory skills					
Time	.47	3.31	12,35	.00**	.53
Group	.90	.71	6,41	.64	.09
Time x group	.54	2.46	12,35	.01*	.45
Psychological measures					
Time	.66	3.22	6,39	.01*	.33
Group	.97	.30	3,42	.82	.02
Time x group	.83	1.27	6,39	.29	.16

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S3

Results of the Doubly MANCOVA's Predicting the Physical (without physical activity), Self-regulatory effectiveness (and frequency), and Psychological Measures

Variable	Wilk's Lambda	*F*	*df*	*p*	Partial eta squared
Physical measures					
Time	.42 (.52)	4.48 (4.74)	10,33 (8,35)	.00*** (.00***)	.57 (.52)
Group	.83 (.87)	1.50 (1.50)	5,38 (4,39)	.21 (.23)	.16 (.13)
Time x group	.87 (.93)	.45 (.35)	10,33 (8,35)	.91 (.94)	.12 (.07)
Self-regulatory skills					
Time	.49 (.47)	2.85 (3.31)	12,33 (12,35)	.00** (.00**)	.50 (.53)
Group	.85 (.90)	1.11 (.71)	6,39 (6,41)	.37 (.64)	.14 (.09)
Time x group	.67 (.54)	1.33 (2.46)	12,33 (12,35)	.24 (.01*)	.32 (.45)
Psychological measures					
Time	.66	3.22	6,39	.01*	.33
Group	.97	.30	3,42	.82	.02
Time x group	.83	1.27	6,39	.29	.16

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S4

Results of the Repeated Measures ANCOVA's Predicting the Physical, Self-regulatory Effectiveness (and frequency), and Psychological Measures

Variable	*F*	*df*	*p*	Partial eta squared
Physical measures				
Weight				
Time	19.12	2,47	.00***	.28
Group	.59	1,48	.45	.01
Time x group	1.01	2,47	.34	.02
Waist				
Time	13.11	2,42	.00***	.23
Group	2.36	1,43	.13	.05
Time x group	.91	2,42	.39	.02
Body Fat				
Time	3.70	2,42	.04*	.08
Group	3.94	1,42	.05*	.08

Time x group	.47	2,42	.60	.01
BMI				
Time	15.29	2,47	.00***	.24
Group	2.82	1,48	.10	.05
Time x group	.94	2,47	.36	.02
Physical Activity				
Time	2.37	2,47	.09	.05
Group	.85	1,48	.36	.02
Time x group	.68	2,47	.51	.01
Self-regulatory skill effectiveness (frequency)				
Delayed gratification				
Time	9.56 (16.53)	2,45	.00*** (.00***)	.17 (.26)
Group	3.60 (3.04)	1,46	.06 (.08)	.07 (.06)
Time x group	5.77 (7.38)	2,45	.00** (.00**)	.11 (.14)
Thought control				
Time	15.02 (10.67)	2,45	.00*** (.00***)	.25 (.19)

Group	3.09 (1.43)	1,46	.09 (.23)	.06 (.03)
Time x group	6.05 (9.47)	2,45	.00** (.00**)	.12 (.17)
Goal setting				
Time	5.38 (6.00)	2,43	.01* (.00**)	.11 (.11)
Group	1.83 (.97)	1,44	.18 (.33)	.04 (.02)
Time x group	.98 (1.10)	2,43	.38 (.33)	.02 (.02)
Self-monitoring				
Time	6.69 (3.90)	2,45	.00** (.04*)	.13 (.08)
Group	4.89 (3.72)	1,46	.03* (.06)	.10 (.07)
Time x group	3.22 (.62)	2,45	.05* (.06)	.07 (.01)
Mindfulness				
Time	3.29 (1.77)	2,45	.04* (.18)	.07 (.04)
Group	1.15 (1.01)	1,46	.28 (.31)	.03 (.02)
Time x group	.87 (.17)	2,45	.41 (.78)	.02 (.00)
Coping				
Time	15.05 (15.50)	2,45	.00*** (.00***)	.25 (.25)

Group	.71 (.81)	1,46	.40 (.37)	.02 (.02)
Time x group	.95 (.90)	2,45	.39 (.41)	.02 (.02)
Psychological measures				
Self-efficacy				
Time	1.76	2,44	.17	.04
Group	.22	1,45	.64	.01
Time x group	3.60	2,44	.03*	.07
Self-regulatory success				
Time	2.59	2,46	.08	.05
Group	.00	1,47	.96	.00
Time x group	2.97	2,46	.06	.06
Physical self-worth				
Time	3.80	2,47	.03*	.07
Group	.37	1,48	.55	.01
Time x group	1.20	2,47	.31	.03

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.