Delineating the psychological and behavioural factors of successful weight loss maintenance

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Research article

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ABSTRACT

Overweight and obesity present alarming global health problems including detrimental health risks that call for effective interventions. Considerable research has examined behavioural and psychological factors associated with weight loss to advance the field of obesity and overweight. In line with the literature, this study aimed to develop a behavioural and psychological profile based on factors of personality, eating behaviours, emotional functioning, physical well-being, and psychopathology. The sample consisted of 105 community participants who had reduced their bodyweight by at least 10% and had either successfully maintained their weight loss for a minimum 12-month period ($n = 41$) or had regained their weight loss within 12 months ($n = 64$). Participants completed an online survey comprising demographic items and four empirical measures (Mini Marker Personality Scale, Patient Health Questionnaire, Three-Factor Eating Questionnaire-Revised, and a food screening tool). Based on significant bivariate correlations results, four factors (fat intake, restrained eating, uncontrolled eating, and emotional eating) were entered into a binary logistic regression. Restrained eating was the only factor that significantly increased the likelihood of predicting successful long-term weight loss. Findings have implications for overweight and obesity future research, which may guide the direction of obesity and overweight treatments.

1. Introduction

Obesity and overweight have reached pandemic proportions (Ng et al., 2014). In 2016, approximately 1.3 billion adults were overweight globally, and of these more than 650 million were clinically obese (World Health Organisation; WHO, 2018). It is estimated that overweight individuals (BMI >25 kg/m^2) will increase from 1.3 billion to 2.0 billion by 2030 (Gundu, 2018). Overweight and obesity are linked to numerous detrimental health-related problems, such as diabetes, high blood pressure, musculoskeletal disorders, and cardio vascular disease (Colaguiri et al., 2010). Overweight and obesity present significant social implications, profoundly limit individuals' engagement in the workplace, community, and family life (Australian Bureau of Statistics [ABS], 2011), in addition to the significant financial implications for the health sector.

As global estimates of obesity reach alarming levels, greater research attention is required on best practice treatments for obesity and overweight-related health problems. In determining intervention efficacy, it is imperative to delineate the criteria that constitutes significant weight loss and successful weight loss maintenance. A large body of work has suggested that long-term maintenance of weight loss comprises a complex interplay of behavioural and psychological constructs. In line with prior research, this study aimed to examine behavioural and psychological factors that assist in predicting successful long-term weight loss maintenance (i.e., a reduction of 10% or more of the heaviest bodyweight for a minimum 12-month period; Wing and Hill, 2001). Development of a successful weight loss profile may help inform public health promotion and intervention strategies to benefit individual well-being.

1.1. Theoretical underpinnings

Considerable research has attempted to ameliorate the causes of overweight and obesity by examining behavioural aspects and psychological factors of weight loss maintenance. Externality theory posits that external cues are largely associated with weight problems. Studies have found external food-related stimuli (e.g., food advertisements) are associated with greater consumption of snack food by obese individuals compared to controls (Halford et al., 2004). According to psychosomatic theory, overeating is considered a coping mechanism in response to negative affect (Abramson and Wunderlich, 1972; Van Strien et al., 1986). Obesity and overweight are thought to develop following early

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learning experiences, which altered the body's normal physiological response to anxiety and hunger (McKenna, 1972). Maladaptive coping strategies are therefore implicated in this dysregulation of negative affect (e.g., anxiety) through food consumption (Evers et al., 2010). In contrast, restraint theory suggests obesity is largely due to psychological processes (Braet et al., 2014; Ogden, 2009; Stice et al., 2005; Stroebe et al., 2013), where individual attempt to cognitively control their eating behaviours (Herman and Mack, 1975; Stice et al., 2005). Interruption of the cognitive processes can result in uncontrollable food consumption. Restraint theory has been strongly associated with binge-eating behaviours and subsequent weight gain (Bailly et al., 2012; Ogden, 2009).

1.2. A complex picture

The literature has identified many key factors relating to weight loss across the lifespan. In 2005, Elfhag and Rössner parsimoniously synthesised a number of findings to propose specific variables that contribute to successful weight maintenance, which included: a self-imposed weight loss goal, engagement in physical activity, consistent monitoring of food intake, adherence to a regular meal rhythm, healthier food choices, stable personal life, together with lower levels of mood disorders (i.e., depression), negative affect, binge eating, and weight instability. While this profile provides some guidance on important contributing factors, aspects of personality were not observed. In as separate examination of personality characteristics and eating behaviours of obese individuals, Elfhag and Rössner (2005) found individuals high on neuroticism were more likely to significantly reduce their caloric intake when dieting, which in turn led to greater weight loss. However, it has been suggested that higher levels of neuroticism may also increase an individual's susceptibility to psychological and emotional difficulties, resulting in weight regain (Sutin et al., 2011). In contrast, lower dietary disinhibition has been consistently identified as a strong predictor of weight loss maintenance. Specifically, an increased tendency to overeat in the presence of palatable food, which may be connected to impulse-control personality traits (Wing and Phelan, 2005). Collectively, prior research suggests that individuals who exhibit better control of their eating behaviours are more successful in maintaining weight loss over time.

1.3. Current study

Based on a detailed review of the literature, the current study identified the following behavioural and psychological factors as possible predictors of weight loss maintenance: personality (Elfhag and Rössner, 2005; Munro et al., 2011; Sullivan et al., 2007; Sutin et al., 2011; Wing and Phelan, 2005), eating behaviours (Elfhag and Rössner, 2005; Shick et al., 1998; Sutin et al., 2011; Wing and Phelan, 2005; Westenhoefer, 2001), emotional functioning (Elfhag and Rössner, 2005), and psychopathology (Klem et al., 1998).

In line with prior research detailed, the current study hypothesised that:

I. Restrained eating, fruit and vegetable intake, emotional stability, conscientiousness, openness, and extroversion would positively predict group membership.
II. Fat intake, anxiety, depression, somatic concerns, neuroticism, agreeableness, uncontrolled eating, and emotional eating would negatively predict group membership.
III. Predictors that strongly predict group membership would significantly improve the logistic regression model's predictive capability.

2. Method

2.1. Participants and procedure

The sample consisted of 105 participants (18–79 years; $M = 36.08$; $SD = 14.20$), comprising 91 women and 15 men. Forty-one participants had

lost $\geq$10% of their maximum body weight and maintained the weight loss for minimum 12-month period (Maintainers) and 64 participants had lost $\geq$10% of their maximum body weight but had regained their weight within 12 months (Regainers). Mean period of weight loss maintenance was 1.67 years. Approximately 58.1% were married or lived de-facto, 22.0% were single, 64.7% had completed an undergraduate or post-graduate degree. Most participants (83.8%) used diet, exercise, and a commercial weight loss programs (e.g., Weight Watchers) to initiate weight loss, while 65.7% continued diet and exercise for weight loss maintenance. The study received ethics approval from the university's Human Research Ethics Committee. The convenience sample were recruited via social media and external organisations using an online survey link. Inclusion criteria included minimum 18 years of age and informed consent was required prior to survey commencement.

2.2. Materials

Participants completed an anonymous and voluntary online questionnaire comprising demographic items (e.g., sex, age, height, weight) and the following measures outline below.

Mini Marker Personality Scale (MMPS; Saucier, 1994).

The MMPS was used to assess the Big Five personality factors. Respondents use a 9-point Likert scale to rate how accurately 40 items (8 items per factor) apply to them, ranging from 1 = Extremely Inaccurate to 9 = Extremely Accurate. High factor scores indicate higher levels of the personality factor (Seibert and Kraimer, 2001). Scale factors have good reported internal consistencies (e.g., .78 for openness; .83 for extroversion; Thompson, 2008). Cronbach's alphas in the current sample ranged from acceptable to good: extroversion ($\alpha = .81$), agreeableness ($\alpha = .79$), conscientiousness ($\alpha = .79$), emotional stability ($\alpha = .83$), and openness ($\alpha = .84$).

2.2.1. Patient Health Questionnaire (PHQ; Spitzer et al., 1999)

The PHQ self-report measure was used to screen for disorders such as major depressive disorder, disordered eating, and general life stress (Spitzer et al., 1999). Respondents assess how often they have experienced specific symptoms on a Likert-type scale, while somatic symptoms are evaluated using dichotomous yes/no responding. High item endorsement can indicate the presence of certain psychiatric diagnoses (Spitzer et al., 1999). The PHQ has good psychometrics (e.g., 85% accuracy, 75% sensitivity, & 90% specificity; Spitzer et al., 1999). The scale presents good internal consistency, $\alpha = .80$ (Gierk et al., 2015), with excellent alphas in the current sample (.89, .81, and .87 for depression, somatic, and anxiety, respectively).

2.2.2. Three-Factor Eating Questionnaire-Revised 18-Item (TFEQ-R-18; Karlsson et al., 2000)

The TFEQ-R-18 was used as a measure of three aspects of eating behaviour: restrained eating (i.e., conscious restriction of food for weight control), uncontrolled eating (i.e., tendency to consume abnormal amounts of food prompted by loss of control and hunger), and emotional eating (i.e., ability to resist emotional eating cues). Responses to 18 items are provided using a four-point Likert scale ranging from 1 = Definitely True to 4 = Definitely False. Higher subscale scores greater levels of restrained, uncontrolled, or emotional eating. The TFEQ-R-18 has demonstrated discriminant validity, differentiating eating styles in 1,175 community members (De Lauzon et al., 2004). Internal reliability in the current sample ranged from acceptable to excellent ($\alpha = .70$, $\alpha = .90$, and $\alpha = .87$ for restrained, uncontrolled and emotional eating, respectively).

2.2.3. Block food screener (Block et al., 2000)

The Food Screener is a brief dietary and nutrient intake measure that assesses the frequency of consumption of certain foods (Block et al., 2000). Respondents indicate the intake frequency of items such as fruit, vegetables, dark bread, and fried chicken using a Likert-type scale (e.g., 0 = Less than 1 per week, 5 = 2+ a day). Scores are summed to yield a

total. The measure has been found to differentiate people with better dietary intake (Block et al., 2000).

3. Results

3.1. Preliminary analyses

A bivariate correlation matrix was produced to determine which of the independent variables significantly correlated with the dependent variable and is presented in Table 1. Subsequently, four significant predictors (restrained eating, uncontrolled eating, emotional eating, and fat intake) were entered into the logistic regression model with the dichotomous dependent variable (group membership). G*Power analysis indicated the current sample size ($N = 105$) was adequate to detect a medium effect ($p = .05$).

3.2. Logistic regression

The omnibus model for the logistic regression analysis was statistically significant, χ^2 ($df = 4$, $N = 105$) = 20.18, $p < .001$, Cox & Snell $R^2 = .18$ and Nagelkerke $R^2 = .24$. The model correctly classified 64.8% of cases (see Table 2). Restrained eating was the only predictor that significantly improved the model's predictive capability, recording an odds ratio (OR) of 1.04. Fat intake, uncontrolled eating, and emotional eating did not significantly influence the probability of predicting successful weight loss maintenance.

4. Discussion

The current study aimed to delineate a psychological and behavioural profile of successful weight loss maintainers using key factors identified in prior research. A logistic regression analysis was conducted to determine whether successful weight loss maintenance could be predicted from factors of restrained, uncontrolled eating, emotional eating, and fat intake. Results partially supported hypotheses. Restrained eating was positively and significantly associated with whether participants would maintain their weight loss. Fat intake, uncontrolled eating, and emotional eating were negatively and significantly associated with maintenance or regaining. However, personality and psychopathology predictors did not appear to significantly influence the likelihood of successful weight loss maintenance.

Table 2. Logistics regression predicting likelihood of maintaining weight loss (N = 105).

	B	SE (B)	Wald	df	p	Odds Ratio [95% CI]
FI	-.03	.03	.71	1	.40	0.98 [0.92, 1.03]
RE	.04	.01	9.02	1	.00**	1.04 [1.01, 1.07]
UE	-.01	.01	1.18	1	.28	.99 [0.96, 1.01]
EE	-.01	.01	.72	1	.40	.99 [0.97, 1.01]
Constant	-.93	1.08	.74	1	.39	.40

Note. *$p < .05$; **$p < .01$. CI = confidence interval. FI = Fat Intake, RE = Restrained Eating, UE = Uncontrolled Eating, EE = Emotional Eating.

A larger community movement, influenced by a variety of diets and eating philosophies that adhere to food restriction, help to explain present findings. More than half of the participants (56%) used a weight loss program (e.g., Weight Watchers, The Paleo Diet) in their initial weight loss and throughout their weight loss maintenance. Such programs endorse food restriction through portion control or avoidance of certain foods. Research has suggested that such eating models can shape societal trends by influencing individuals' day-to-day decisions regarding food consumption (Johnson, 2016). Assuming a broader societal shift, the restriction of food intake may be omnipresent, particularly for individuals seeking to lose weight and maintain weight loss long-term. In contrast, individuals who lose weight but regain it within a 12-month period may initially begin by restricting food intake, however, slowly return to their pre-weight loss eating patterns.

Food restriction is identified in the literature as a common method used among successful weight maintainers. Stroebe et al. (2013) postulates that certain individuals who engage in successful restrained eating are able to better maintain their weight loss as a result of a loss enjoyment in eating. That is, a weaker hedonic response is activated by exposure to palatable food, which makes resisting food temptations more manageable for particular individuals. Current results offer support for this association between disinhibited eating and successful weight maintenance. Additionally, an association between an increased tendency to overeat in the presence of palatable food and personality traits related to impulse control has been identified (Wing and Phelan, 2005). Individuals who are able to better control their eating behaviours are more successful in maintaining their weight loss over time. Future

Table 1. Bivariate Pearson's correlation matrix for independent variables and the dependent variable.

	Ex	Ag	Con	Emo	Op/In	RE	UE	EE	Dep	Som	Anx	FVI	FI	GM	SFVI
Ex	-	.06	.36**	.25*	.22*	.02	-.09	.16	-.38**	-.24*	-.28**	.23*	.06	-.08	.24*
Ag	-	-	.30**	.32**	.26**	-.08	-.27**	.11	-0.3	-.12	-.12	-.08	-.10	.05	.16
Con	-	-	-	.24*	.37**	.04	-.09	-.08	-.24*	-.17	-.26**	.13	.04	.07	.14
Emo	-	-	-	-	-.00	-.18	.33**	.29**	-.43**	-.38**	-.47**	.04	-.02	-.08	.10
Op/Int	-	-	-	-	-	.04	.04	-.03	.09	.10	.08	.16	-.00	.08	.09
RE	-	-	-	-	-	-	-.04	-.09	.13	.15	.15	.17	-.38**	.35**	.30**
UE	-	-	-	-	-	-	-	.65**	.45**	.26**	.22*	-.04	.14	-.20*	-.10
EE	-	-	-	-	-	-	-	-	-.43**	-.27**	-.21*	-.16	.13	-.21*	-.19*
Dep	-	-	-	-	-	-	-	-	-	.73**	.75**	-.09	-.01	-.09	-.13
Som	-	-	-	-	-	-	-	-	-	-	.73**	-.02	.06	-.11	-.06
Anx	-	-	-	-	-	-	-	-	-	-	-	.05	.03	-.05	-.01
FVI	-	-	-	-	-	-	-	-	-	-	-	-	.09	.11	.68**
FI	-	-	-	-	-	-	-	-	-	-	-	-	-	-.23*	-.08
GM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.19
SFVI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. *$p < .05$ level (2-tailed), **$p < .01$ level (2-tailed) Ex = extroversion; Ag = agreeableness; Con = conscientiousness; Emo = emotional stability; Op/Int = openness/intellect; RE = restrained eating; UE = uncontrolled eating; EE = emotional eating; Dep = depression; Som = somatic; Anx = anxiety; FVI = fruit and vegetable intake; FI = fat intake; GM = group membership (Maintainers, Regainers); SFVI = short fruit and vegetable intake.

research could examine impulse control as a key factor in the psychological and behavioural profile of successful weight loss management.

Current results offer strong support for restraint theory in explaining the causes and consequences of food restriction in weight loss maintenance (Ogden, 2009). Restraint theory argues that individuals rely on their cognitive capacity to control their eating behaviours and food is consumed uncontrollably in the event the cognitive processes are interrupted (Herman and Mack, 1975; Stice et al., 2005). Research also suggests that dietary restraint result in a depletion of certain neurotransmitters such as tryptophan, prompting overeating of carbohydrate-rich food in an effort to reinstate appropriate levels of tryptophan (Kaye et al., 1998). Despite small significant negative correlations for uncontrolled eating and emotional eating in current results, the variables did not make a unique contribution to the logistic regression. It could be that these two variables do contribute significantly to weight loss maintenance, however the current sample size may have lacked statistical power to detect a small effect.

The lack of significant results among a number of proposed predictors in the current study suggest alternative factors may significantly contribute to the predictive model. Although outside the scope of the present study, a number of biological mechanisms have been implicated in the regulation of bodyweight (Kosmiski et al., 2014). According to set point theory (Nisbett, 1972), the body will return to its prior bodyweight when a normal diet is reinstated (Kosmiski et al., 2014). Biological factors such as leptin and insulin, two adiposity-related signals, are reduced when bodyweight is reduced. Consequently, hunger and reduced feelings of satiety can increase, which in turn can trigger in increased food intake and weight regain (Cornier, 2011). Additionally, studies in the field of epigenetics suggest an underlying system, beneath the behavioural and psychological factors contributing to weight loss maintenance, which develops over time (Slack, 2002). Assuming the underlying system ultimately results in the expression of a phenotype, it is the phenotype that is regulated rather than weight (Bessesen, 2011). Such theory indicates that contemporary models of weight regulation that delineate the complex interplay between psychological, behavioural, and biological factors are crucial in developing a predictive model of successful weight loss.

4.1. Methodological considerations

Present findings contribute to the growing body of literature concerning long-term weight loss maintenance; however, several study *limitations* should be noted. Firstly, sample size may have limited the detection of small but significant effect sizes among independent variables, particularly in the case of uncontrolled eating and emotional eating variables. Future research in larger samples may help identify factors associated with long-term weight loss and maintenance that are generalisability to the adult population. Secondly, social desirability and the under and over reporting of body measurements such as weight and height may have impacted results. Women in particular, have been found to underestimate their weight (Engstrom et al., 2003) and the current sample consisted 91% women. To address such potential confounds, social desirability scale could be included as a covariate in analyses, and participant weight and height measures attained by researchers where possible, to ensure data accuracy.

4.2. Future research

Research indicates that a complex interplay of biological, psychological, and behavioural factors is associated with long-term weight maintenance. Therefore, additional factors should be considered in establishing a weight loss maintainer profile beyond psychological and behavioural motivation behind food restriction, which could help inform intervention strategies. Research has suggested that weight loss maintenance is associated with changes in neural activity in areas of the brain responsible for emotional and cognitive aspects of eating behaviours (Rosenbaum et al., 2008). Specifically, participants' responses to visual food cues changed after a 10% reduction in bodyweight. Future research involving functional magnetic resonance imagining (fMRI) may help to determine if neuronal activity adjustments contribute to the long-term maintenance of weight loss. Subsequent findings may highlight the role of pharmacological intervention in contributing to weight loss and maintenance.

5. Conclusion

Given the increasing global prevalence of overweight and obesity, determining key factors that differentiate individuals for those who maintain or regain weight loss has significant implications for the direction of intervention. Such research may influence government recommendations regarding issues such as nutrition advice, which in turn may inform societal understanding of the consequences of obesity, overweight, and general health (Johnson, 2016). Consistent with prior research, current results suggest that restrained eating is central to long-term reduced weight maintenance. However, in contrast with prior research, no additional significant psychological and behavioural predictors added to the predictive model of a successful weight loss maintenance examined. Future research could explore biological mechanisms, through genetic testing, to help delineate the biological factors that contribute to the profile of successful weight loss maintainers. Such finding may have important implications for the development of weight loss intervention strategies which will benefit individual well-being.

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