Cloud Publications
International Journal of Advanced Nutritional and Health Science
2019, Volume 7, Issue 1, pp. 343-353
ISSN 2348-5140, Crossref: 10.23953/cloud.ijanhs.434

Research Article

Psychosocial and Behavioral Predictors of Successful Weight Loss in Individuals that are Obese

Hildemar Dos Santos[1], Henrik Galust[2], Sylvia Cramer[3], Colwik Wilson[4], Susanne Montgomery[5], Denise Tavares Schwab Dias[6], Josileide Gaio[1]

[1]School of Public Health, Loma Linda University, Loma Linda
[2]University of Colorado, Denver
[3]School of Medicine, Loma Linda University, Loma Linda
[4]Oakwood University, Alabama
[5]Behavioral Health Institute, Loma Linda University, Loma Linda
[6]School of Allied Health Professions, Loma Linda University, Loma Linda

Correspondence should be addressed to Josileide Gaio, *jgaio@llu.edu*

Publication Date: 26 September 2019

DOI: https://doi.org/10.23953/cloud.ijanhs.434

Abstract The objective of this study was to evaluate psychosocial and behavioral predictors of weight loss success in patients that are obese enrolled in a weight loss program. It was a quasi-experimental design, with a convenience sample (n=127) of men and women aged 21-75 years with BMI >30 kg/m^2 enrolled in a medically supervised comprehensive clinic-based weight loss program. We performed assessments at baseline and after program completion via behavioral and psychosocial questionnaires exploring correlates of weight loss. The weight loss program included nutritional, physical and behavioral therapies. Surveys and scales assessed baseline major and daily life events as stressors that may affect weight loss. Pre-treatment perceived importance and actual engagement in weight loss behaviors - monitoring of eating behaviors, of meals and physical activity - also assessed. Multiple linear regression models were used, and an alpha (p-value) ≤0.05 determined statistical significance. Participants obtained clinically significant weight loss of 7% from baseline. Pre-treatment engagement in weight loss behaviors ($p<0.05$) was a significant and independent predictor of weight loss; depression was negatively associated with weight loss ($p<0.05$). Major and daily stressors were not predictive of weight loss success. Baseline weight losing behaviors increase the likelihood of success; baseline depression decreases the likelihood of success in weight loss. Appropriate pre-treatment screening of behaviors and depression treatment may improve weight loss program success.

Keywords *behavior predictors; obesity; psychosocial predictors; weight loss program*

1. Introduction

In the past few decades, the prevalence of obesity among adults in the U.S. has sharply increased to more than 30% of the population (CDC, 2015; Meldrum et al., 2017). Consequently, more Americans

are suffering and dying of highly preventable conditions, costing the U.S. hundreds of billions of dollars each year (CDC, 2015).

Studies show that losing as little as 5-10% of total body weight (considered modest weight loss) can greatly reduce the health risks associated with obesity, improving or even preventing type 2 diabetes, hypertension, hypercholesterolemia, coronary heart disease, certain cancers and strokes (CDC, 2015; Apovian, 2013). Therefore, multidisciplinary programs that focus on positive lifestyle changes and provide expert advice in nutrition, health education, exercise and behavior therapy, showed to achieve this level of weight loss (Obert et al., 2017; Dos Santos et al., 2019). However, despite the knowledge of what is needed to achieve weight loss, it is difficult and complex to predict success of treatments (Kerrigan et al., 2018; Carraca et al., 2018). Regardless of increasing efforts by Americans to lose weight, the epidemic of obesity continues to worsen (Smith & Smith, 2016).

With current interventions generating inadequate results, perhaps additional psychosocial and behavioral factors should be explored, such as stress. Various environmental factors (e.g. stressful life changes) (Tomiyama, 2019), combined with unhealthy baseline behaviors and inadequate coping skills lead to stressors that greatly impact homeostasis (Schneiderman et al., 2005). As a major control center in the brain, the hypothalamus stimulates neuronal circuits and endocrine pathways when exposed to stress that lead to elevations of glucocorticoid and epinephrine levels (Tsigos & Chrousos, 2002; Dos Santos et al., 2019). Under chronic exposure, this can lead to behavioral and metabolic alterations that cause weight gain. Therefore, the higher the level of stress, the higher the potential for weight gain and subsequent health problems (Tomiyama, 2019). On the other hand, stress coping can effectively help patients to lose and maintain weight (Geiker et al., 2018).

Stress relates to obesity, but limited studies explored the influence of stress on weight control treatment. We aimed to explore whether pre-existing baseline psychosocial and behavioral variables can predict treatment outcomes of patients enrolled in a weight loss program.

2. Methods

2.1. Participants

Participants were obtained via convenience sampling of obese and morbidly obese (BMI >30 kg/m^2) men and women ages 21-75 enrolled in the Lite-Weighs program. From September 2009 to February 2010 all new applicants to Lite-Weighs were offered to participate in the study. After attending a group orientation session for an overview of the program, a total of 127 participants enrolled and were included in the study. Patients with cancer, pregnancy, or any medical contraindications to calorie-restricted diets or low-fat diets were excluded from the study. Those who chose to participate gave informed consent and signed an agreement to attend 26 weekly one-hour sessions. Participants paid for their meal replacements, provider co-pays, and material fees, with all remaining program costs, waived for participation in the study. The Loma Linda University Institutional Review Board approved the de-identified database and all procedures.

2.2. Intervention

Lite-Weighs is a 26-week medically supervised weight loss program operated by the Beaver Medical Clinic in Redlands, California. The program served patients that were overweight, obese, and morbidly obese who are self-referred or physician-referred. Lite-Weighs focused on health education, lifestyle skill development, behavior modification, nutrition, and physical activity. Diet supplements and adjunct medications were also available when needed to enhance weight loss.

The goal of the Lite-Weighs treatment program was to support patients in learning and practicing lifestyle skills and health habits needed to lose weight, maintain weight loss, and improve overall health. Personalized attention and follow-up care are central to this medically directed program led by an interdisciplinary staff trained in behavior modification, weight management, and exercise physiology. The team included physicians, preventive care specialists, health educators, medical assistants, and a personal trainer. Lite-Weighs physicians designed an individualized program for each patient during the first visit. The intervention team led subsequent weekly meetings, which included a one-hour class sessions for 26 weeks. Additionally, patients met again with the Lite-Weighs physician or their personal physician every 3-4 weeks or earlier when medically necessary.

2.3. Assessments

Before starting the treatment protocol, each participant completed an array of medical history assessment forms and pre-treatment psychosocial and behavioral questionnaires. All forms and surveys were self-administered in a quiet study room with an interventionist available to answer any questions. Participants repeated the psychosocial and behavioral questionnaires at the end of treatment (26 weeks) for comparison with baseline responses.

Trained data collectors extracted demographics from the questionnaires (Table 1). The presence of any obesity-related medical illness (e.g. cardiovascular disease, type 2 diabetes, osteoarthritis, and endocrine disorders), medication lists, current level of physical activity, family history of obesity, tobacco and alcohol use was also recorded based on participants' written responses. Beaver Medical Clinic medical assistants obtained anthropometric data (e.g. height, weight, waist circumference and BMI).

2.4. Measures

This study employed a quasi-experimental design using four different questionnaires that measured specific baseline qualities. Based on these qualities, the authors hoped to find particular patient characteristics that predict success or failure in a medically supervised weight management program. The questionnaires measured prior engagement in weight loss behaviors (Stunkard, 1993; Wadden et al., 1992; Wing, 2003) how much importance a patient placed in engaging in weight loss behaviors, (Becker & Maiman, 1995) major life events (Holmes & Rahe, 1967) and levels of daily hassles and uplifts (DeLongis et al., 1988) which can affect weight loss outcomes.

Major Life Change Events Questionnaire. The Life Change Event Scale was designed to predict the likelihood of disease (obesity) and the readjustment (weight loss) needed to obtain homeostasis following exposure to stressful life events. Events on the scale may be both negative and positive experiences that induce stress. Patients were asked to identify any stressful event they had endured, any association of the event with their current health status, and then scored the event based on the amount of readjustments they had to make as a result of the event. In case an event occurred more than once, patients were instructed to multiply their total scored by the number of occurrences. A total score of 300 or more indicates major risk of disease; a score of 150-299 indicates moderate risk, and a score of 150 and below suggests a slight risk of disease. Higher scores not only indicate a greater risk for disease but also greater efforts needed to reach a desirable weight.

There is a voluminous literature documentation that life events are related to a variety of physical and psychological problems both in cross sectional and longitudinal research. In terms of reliability a test-retest correlation of r=0.94 was found for total number of events in a short-term study (retest in 7-14 days). For a longer retest reliability was much lower, r=between 0.30 and 0.40.

The validity of the scale was tested in a study of 18 patients with schizophrenia that found a mean intrapair agreement for all events on the PERI checklist of 0.22 with a range of 0 to 0.42. The Department of Veterans Affairs conducted another study with a sample of 102 non patient men and found a value of 0.33 reported by either the respondent or a significant other (Dohrenwend, 2006).

The Hassles and Uplifts Scale. The Hassles and Uplifts Scale is an alternative to the Major Life Change Events approach of measuring stressors. Instead of focusing on highly charged life events, the 53-item scale provides a more comfortable way to evaluate positive and negative events that occur in daily life, empowering clients to develop strategies for dealing with hassles and enhancing the occurrence of uplifts. The scale suggests positive aspects of daily life counteract the damaging effects of stress. It takes approximately 10 minutes to complete this questionnaire. It is graded on a scale from 0 to 3 for positive interactions: 0 = none, 1 = somewhat, 2 = quite a bit, and 3 = a great deal.

The reliability of the Hassles and Uplift Scale was measured by a test-retest process and showed adequate both for the Hassles component (r=0.79 frequency and r=0.48 intensity) and for the Uplifts component (r=0.72 frequency and r=0.60 intensity). The validity for the scale has shown a pattern of hassles and uplifts endorsements that would be anticipated for individuals of varying age groups (Kanner et al., 1981).

Weight Management Behavior Questionnaires. In addition to the questionnaires that assessed the impact of daily and major life events, two weight loss behavior questionnaires were used in this study. Patients were asked to quantify perceived importance and frequency of engaging in 17 different weight loss promoting behaviors. The questions focused on three main categories: self-monitoring, eating habits, and physical activity. Self-monitoring questions assessed whether patients were daily monitoring behaviors like caloric intake, food portions, the amount of exercise and weight values. Eating habit questions asked about menu and meal planning, food portions, restaurant eating, and thoughts about healthy eating. Physical activity questions recorded whether patients exercised at least 60 minutes per day, participated in supervised sessions on changing exercise-related thinking and exercised even when not in the mood.

The questionnaires were not checked for reliability. The only validity tests that were done with the questionnaires found correlations of self-monitoring behaviors and behavior frequency of r=0.42 after a 4 weeks program with 37 participants. Same study found a correlation between the willingness of self-monitoring behaviors with weight loss at 12 weeks of r=0.40; Behavior frequency of self-monitoring and weight loss at weeks 4, 8 and 12 of r=0.38, 0.53 and 0.41 respectively; perceived importance for exercise behavior and weight loss at 12 weeks of r=-0.45; and willingness to exercise behavior and weight loss at 12 weeks of r=-0.38. The last two values were saying that the instrument failed to predict weight loss in this study (Mathur, 2007).

Anthropometry. Medical assistants measured the height using a wall-mounted stadiometer without shoes, keeping heels, buttocks, shoulders, and occiput in the vertical plane and head in the anatomic plane. Values were rounded to the nearest 0.1 cm. Weight was measured using a digital scale (Perspective Enterprise, Inc.) without shoes, minimal lightweight clothing, rounded to the nearest 0.1 kg. BMI was calculated by the formula kg/m^2. Waist circumference was measured in centimeters using a measuring tape around the bare abdomen just above the hip bone at the level of the navel.

2.5. Power Analysis

Using G-Power we determined that we had sufficient power with the 100 persons who completed the psychosocial questionnaire, noting that with a multiple regression we could model weight change on

continuous independent variables (Xs) and achieve 85% power at the 0.05 significance level (two-sided) to detect a change in R- squared of 0.08.

2.6. Data Analysis

After abstraction of patient's files, data entry was done using SAS software (version 9.2, SAS Institute Inc., Cary, NC, 2013). A random 10% sample was re-entered. The dependent variables (weight change, BMI change, waist circumference change) were examined for normality and the distributions were acceptable. Descriptive analysis was performed on participant's baseline variables and expressed as mean standard deviations. Paired t-test was used to evaluate the change in weight, BMI, and waist circumference at 26 weeks. The chi-square test was used to analyze categorical variables (changes in weight, BMI, and waist circumference). Analyzes used the intent-to-treat approach with Last Observation Carried Forward method. Multiple linear regression was utilized to evaluate predictors of weight loss adjusting for covariates. The dependent variable was weight loss. Models were adjusted for baseline weight. Covariates were examined using bi-variable analyzes and any variables that were significant or that changed the beta coefficient of the treatment variable by 10% were included in the model. The alpha (p-value) ≤0.05 was used to determine statistical significance.

3. Results

Descriptive statistics for the study participants (n=127) are summarized in Table 1. The mean age was 51.4 (SD±1.4). At baseline, the average weight was 112 kg (SD±27.5), and average BMI was 40.5 (SD±8.7). Most participants were female (82%), white (73%), married (62%), employed (54%), had a high school education or less (44%), had never attempted to lose weight (59%), reported mild activity levels (42%), and never smoked (64%). Many had comorbidities such as hypertension (46%), depression (40%), high cholesterol (39%), as well as diabetes (21%), cardiovascular disease (21%) and thyroid disease (17%).

Table 1: *Characteristics of study participants* at baseline intervention (N=127)*

Variables		
Female, N (%)	104	(81.9)
White, N (%)	93	(73.2)
Age (years), mean (SD)	49.8	(±15.6)
Married, N (%)	79	(62.2)
Weight (kg)	112.0	(27.5)
BMI (kg/m²), mean (SD)	40.5	(±8.7)
Waist (cm), mean (SD)	115.5	(±20.2)
Hip (cm), mean (SD)	129.8	(±18.0)
Waist/Hip ratio, mean (SD)	0.89	(±0.09)
Education, N (%)		
High School or less	55	(44.0)
Associate Degree	25	(20.0)
Bachelor's Degree or more	45	(36.0)
Employment, N (%) Employed	68	(54.0)
Unemployed/Disabled/Retired	58	(46.0)
Past weight loss attempts*, N (%)		
No, new participants	75	(59.1)
Yes, attended previously, N (%)	52	(40.9)
Physical Activity, N (%)		
None	25	(19.7)

Mild	55	(43.3)
Moderate/Vigorous	47	(37.0)
Never smoked, N (%)	81	(63.8)
No alcohol, N (%)	83	(65.4)
Comorbidities* N (%)		
Diabetes	26	(20.5)
Thyroid	21	(16.5)
Cardiovascular	27	(21.3)
High cholesterol	51	(39.3)
Hypertension	58	(45.7)
Depression	51	(40.2)

**Participants were treated at "Lite-Weighs" a medically supervised commercial weight loss program.*

Of the 127 participants, only 100 completed the psychosocial and behavioral questionnaires. Therefore, 100 participants were included in the predictive model. Table 2 shows pretreatment test scores for psychosocial and behavioral factors. The average major life event score at baseline was 331.90 (SD 183.23) (300 or more indicates major risk of disease). Average hassles intensity score was 1.89 (SD±0.45), and average uplifts score was 2 (SD±0.41) Results showed that participants experienced a great deal of both hassles and uplifts in their daily lives. However, scores for major life change events and frequency and intensity of daily hassles and uplifts did not predict treatment outcome or weight loss success.

Table 2: *Pretreatment scores for psychosocial and behavioral variables*

Variables/Behaviors	Mean	SD
Life Event Score	331.90	183.23
Hassle Intensity	1.89	0.45
Uplift Intensity	2.00	0.41
Hassle Frequency	21.35	9.64
Uplift Frequency	24.11	11.45
Perceived Importance of Weight Loss Behaviors (self-monitoring, eating and exercise)	70.95	8.66
Sub-Scores		
Perceived importance of Self-Monitoring	23.41	4.56
Perceived importance of Eating Behaviors	26.21	3.03
Perceived importance of Exercise Behaviors	21.59	2.58
Frequency of Weight t Loss promoting Behaviors (self-monitoring, eating and exercise)	51.27	21.76
Sub-Scores		
Frequency of Self-monitoring Behaviors	14.65	9.78
Frequency of Eating Behaviors	24.00	9.15
Frequency of Exercise Behaviors	15.22	7.87

The baseline score for perceived importance of weight loss enhancing behaviors was on average 70.95 (SD±8.66) out of a maximum possible score of 119. The subscale scores for perceived importance of self-monitoring, eating, and exercise behavior were 23.41 (SD±4.56) out of maximum 30 points, 26.21 (SD±3.03) out of 30 points, and 21.59 (SD±2.58) out of 25 points respectively.

In contrast, the average score for frequency of engaging in weight loss enhancing behaviors prior to the start of the intervention was 51.27 (SD±21.76) out of a maximum possible score of 119. The scores for the subscales of actual engagement in weight loss promoting behaviors at baseline were 14.65 points (SD±9.78) out of 42 for self-monitoring behaviors; 24 (SD±9.15) out of 42 points for eating behaviors, and 15.22 (SD±7.87) out of 35 for exercise behaviors.

Overall, weight loss among participants was clinically significant, with an average weight loss of 7.58 kg and approximately 2.74 kg/m² or 6.8% reduction in BMI ($p<0.01$) at 26 weeks (Table 3). Among the psychosocial and behavioral scales, only higher pretreatment frequency of self-monitoring, exercise, and eating habits were associated with greater weight reduction ($p<0.05$). Depression was the only variable found to be negatively associated with weight loss ($p<0.05$) (Table 4).

Table 3: *Change in anthropometric measures (after - before) Intervention (n=127)*

Measures	SD		P-value
Weight change in kg (after - before)	-7.58	(9.7)	<0.0001
Weight change in percent	-6.68		
BMI change in kg/m^2 (after - before)	-2.74	(3.5)	<0.0001
BMI change in percent	-6.68		

**Change in Anthropometric measure is a negative number; Base on Paired t-test analysis.*

Table 4: *Multiple regression analysis for BMI change (after - before) - Using Hassle/Uplift (n=100)*

	Beta	SE	P-value
Intercept	-2.350	3.496	0.5032
Baseline Weight	-0.074	0.042	0.0863
Number of Sessions attended	0.003	0.075	0.9735
Weight Medication use vs. not	-0.820	0.767	0.2877
Physical Activity: Mild vs. not	0.489	0.984	0.6207
Physical Activity: Moderate/vigorous vs. not	-0.002	1.059	0.9985
Thyroid vs. none	0.434	1.027	0.6739
Depression vs. none	1.613	0.748	0.0338
Life Event score	0.001	0.002	0.6341
Hassle Frequency score	-0.017	0.047	0.7133
Uplift Frequency score	0.064	0.039	0.1038
Perceived importance of weight loss behaviors	0.020	0.043	0.6420
Frequency of Weight Loss promoting Behaviors (self-monitoring, eating and exercise)	-0.040	0.020	0.0455

SE, standard error.

4. Discussion

This study showed that higher pretreatment levels of engagement in weight loss enhancing behaviors (such as monitoring eating behaviors, monitoring of meals and physical activity) were associated with greater success in achieving weight loss. These findings are in tandem with previous studies that explored pre-treatment behaviors such as decreasing portions, monitoring caloric intake, using nutritional supplements, (Delahanty et al., 2013; Rolls, 2014) physical activity (Lopez Tarraga et al., 2019) and behavior therapy (Roohafza et al., 2014) – all found to be beneficial traits for weight loss success. The mere perception that such behaviors were important had no significant effect on outcomes; actual engagement in such activities was pertinent. This study showed an inverse relationship between perceptions of weight loss behavior importance and actual engagement in weight loss promoting behaviors. This was consistent with the findings of one similar previous study (Mathur, 2007). Levels of major life changing events and hassles and uplifts were not predictive of weight loss.

This study showed that those who had engaged in previous dieting and other attempts to lose weight were more successful, suggesting the nature of relapse and the need for participants to give clinical weight loss programs multiple tries. Former studies assessing success after previous attempts at

weight loss show mixed results (Teixeira et al., 2004; Painter et al., 2017). This may be better explored by specifying the extent of previous attempts, perhaps in the present study the participants had few relapses and were more motivated not to repeat past mistakes, whereas greater number of past failures diminish weight loss success – a proposed “threshold” phenomenon that warrants further investigation also suggested by Teixeira in a similar study (Teixeira et al., 2004).

Mixed results also exist for exercise-related variables. Some studies support current findings that exercise variables predict weight loss success (Silva et al., 2011). While one similar study failed to see this trend (Teixeira et al., 2004). Differences seem to be related to study samples, suggesting different cultures and geographic locations can influence perceptions and approach to physical activity.

There is ample evidence of a relationship between the number of stressful life events experienced by an individual and the effect on physical and psychosocial wellbeing. The Holmes-Rahe scale (Kale & Stenmark, 1983) measures life events in terms of the changes and readjustments required by an individual to return to homeostasis. On average, the present study found that nearly all of its participants experienced severe levels of major life events that could have contributed to a ceiling effect, thus not showing this variable as important in a multivariable model.

Additionally, when daily hassles and uplifts were explored by Kanner et al. (1981) and DeLongis et al. (1982) they found that hassles, defined as minor but more frequent stressors, have a more profound effect and are more predictive of health outcomes than major life events. While the present study did not find an association between the frequency and intensity of daily hassles and uplifts and weight loss, data did show that individuals diagnosed with depression were less likely to achieve clinically significant weight loss. This is in accordance with Anton et al. (2008) who found that a negative mood state was associated with less weight loss after six months. Also, a meta-analysis by Blaine (2008) confirmed with longitudinal studies that depression is related to obesity. Perhaps it is not the frequent stressors that are problematic, but the impact of these stressors on mood and how individuals respond to the stressors.

5. Limitations

Participants were self-selected in the study and not randomly assigned to groups, affecting the generalizability of the results. However, this is the case in most clinical and commercial weight loss programs. There was a lack of racial and ethnic diversity among study participants. Randomization of participant’s conditions was also needed. Participants were free-living, and other influences on weight were not controlled. Patients may have exaggerated responses to elicit sympathy while some respondents may be too embarrassed to reveal private details or may have under-reported the severity or frequency of health-related information. The number of questions in the English-language only questionnaire may also have influenced compliance with completing the questionnaires. The strength of this study is the a priori selection of variables to be analyzed as predictors and the low dropout rate.

Implications for Research and Practice

Obesity poses many risks to health, quality of life and the economy. Numerous programs exist that intend to reduce the considerable burden of this disease, yet current research shows that evidence is lacking to support these interventions (Tsai & Wadden, 2005). The aim of this study was to evaluate the association among several psychosocial pretreatment predictors and success in weight loss among obese and morbidly obese patients. The benefit of identifying pretreatment behaviors that guide weight loss treatment could lead to a transformation of current weight loss interventions to make success more attainable (Carraca et al., 2018; Stubbs et al., 2011). Results from this study

demonstrated that a medically supervised comprehensive obesity intervention program incorporating nutrition, physical activity, and behavior modification successfully facilitated a weight loss of about 7%. Presently, many weight loss programs use single methods; this study suggests a more comprehensive approach may produce better outcomes.

Baseline level of engaging in weight loss promoting behaviors (eating, exercise, and self-monitoring) and low levels of depression were confirmed as predictors of weight loss, suggesting that clinicians need to be aware of and build on past dieting and lifestyle experiences, and address the effects of baseline depression on weight loss interventions. This study suggests that depression should be screened and treated before initiating a weight loss program, and this is in accordance with the literature. Therefore, an individualized approach to weight loss based on similar baseline screening may increase the efficacy of treatment. Previous attempts at dieting and weight loss increased the likelihood of success in the present study; further studies may need to explore the threshold phenomenon. It is also a finding that providers can use to encourage their patients that past attempts were not in vain and may indicate higher chances of future success. This may resemble smoking cessation behaviors of multiple attempts needed to quit before final cessation is achieved (Chaiton et al., 2016).

Future studies should explore the influence of race and ethnicity on psychosocial factors that may be associated with weight loss outcomes. Especially since obesity rates are higher among minority populations.

References

Anton, S.D. 2008. Psychosocial and behavioral pre-treatment predictors of weight loss outcomes. *Eating and Weight Disorders*, 13(1), pp.30-37.

Apovian, C.M. 2013. The clinical and economic consequences of obesity. *American Journal of Management Care,* 19(11 Suppl), pp.S219-228.

Becker, M.H. and Maiman, L.M. 1975. Sociobehavioral determinants of compliance with health and medical care recommendations. *Medical Care*, 13(1), pp.10-24.

Blaine, B. 2008. Does Depression Cause Obesity? A meta-analysis of longitudinal studies of depression and weight control. *Journal of Health Psychology*, 13(8), pp.1190-1197.

Carraca, E.V., Santos, I. and Mata, J. 2018. Psychosocial pretreatment predictors of weight control: a systematic review update. *Obesity Facts*, 11(1), pp.67-82.

Centers for Disease Control and Prevention. 2015. Obesity and overweight for professionals: data and statistics: adult obesity - DNPAO - CDC. Available from: *http://www.cdc.gov/obesity/data/adult.html*

Chaiton, M. 2016. Estimating the number of quit attempts, it takes to quit smoking successfully in a longitudinal cohort of smokers. *BMJ Open*, 6(6), p.e011045.

Delahanty, L.M. 2013. Pretreatment, psychological, and behavioral predictors of weight outcomes among lifestyle intervention participants in the Diabetes Prevention Program (DPP*)*. *Diabetes Care*, 36(1), pp.34-40.

DeLongis, A., Folkman, S. and Lazarus, R.S. 1988. The impact of daily stress on health and mood: psychological and social resources as mediators. *Journal of Personality and Social Psychology*, 54(3), pp.486-495.

DeLongis, A. 1982. Relationship of daily hassles, uplifts, and major life events to health status. *Health Psychology*, 1(2), p.119.

Dohrenwend, B.D. 2006. Inventorying stressful life events as risk factors for psychopathology: Toward resolution of the problem of intra category variability. *Psychological Bulletin*, 132(3), pp.477-495.

Dos Santos, H., Reis, W.P., Cramer, S., Wilson, C. and Montgomery, S. 2019. Impact of a funded (sponsored) versus an unfunded clinical weight management program on obesity. *Journal of Applied Sciences Research*, 5(3), pp.21-31.

Dos Santos, H., Raphael, J.C., Reis, W.P., Gaio, J., Lee, S.B., Bellinger, D.L. and Lee, J.W. 2019. The association between affect and biomarkers of stress and inflammation in healthy seventh-day Adventists. *Advances,* Summer, 33(3).

Geiker, N.R.W. 2018. Does stress influence sleep patterns, food intake, weight gain, abdominal obesity and weight loss interventions and vice versa? *Obesity Reviews*, 19(1), pp.81-97.

Holmes, T.H. and Rahe, R.H. 1967. The social readjustment rating scale. *J Psychosom Res.*, 11(2), pp.213-218.

Kale, W. and Stenmark, D. 1983. A comparison of four life event scales. *American Journal of Community Psychology*, 11(4), pp.441-458.

Kanner, A.D. 1981. Comparison of two modes of stress measurement: daily hassles and uplifts versus major life events. *Journal of Behavioral Medicine*, 4(1), pp.1-39.

Kerrigan, S.G., Clark, M., Converting, A., Evan, F. and Butryn, M.L. 2018. The association between previous success with weight loss through dietary change and success in a lifestyle modification program. *Journal of Behavioral Medicine*, 41(2), pp.152-159.

Lopez Tarraga, P.J. 2019. Evaluation of a motivational intervention of physical activity program in the treatment of obesity and overweight. *Hipertension Riesgo Vascular*, Pii, pp.S1889-1837(19)30032-7.

Mathur, T.M. 2007. Perceived importance of and willingness to engage in weight loss behaviors among overweight adults. *Department of Health and Physical Activity*, University of Pittsburgh: Pittsburgh. p.124.

Meldrum, D.R. and Morris, M.A. 2017. Gambone, obesity pandemic: causes, consequences, and solutions-but do we have the will? *Fertility and Sterility*, 107(4), pp.833-839.

Obert, J. 2017. Popular weight loss strategies: a review of four weight loss techniques. *Current Gastroenterology Reports*, 19(12), p.61.

Painter, S.L. 2017. What matters in weight loss? An in-depth analysis of self-monitoring. *Journal of Medical Internet Research*, 19(5), p.e160.

Rolls, B.J. 2014. What is the role of portion control in weight management? *International Journal of Obesity (Lond)*, 38 Suppl 1: p.S1-8.

Roohafza, H. 2014. Effect of psychological distress on weight concerns and weight control behaviors. *Arch Iran Med.*, 17(9), pp.608-612.

Schneiderman, N., Ironson, G. and Siegel, S.D. 2005. Stress and health: psychological, behavioral, and biological determinants. *Annual Review of Clinical Psychology*, 1, pp.607-628.

Silva, M.N. 2011. Exercise autonomous motivation predicts 3-yr weight loss in women. *Medicine and Science in Sports and Exercise*, 43(4), pp.728-737.

Smith, K.B. and Smith, M.S. 2016. Obesity statistics. *Primary Care*, 43(1), pp.121-135, ix.

Stubbs, J. 2011. Problems in identifying predictors and correlates of weight loss and maintenance: implications for weight control therapies based on behaviour change. *Obesity Reviews,* 12(9), pp.688-708.

Stunkard, A.J. 1993. Obesity: Theory and Therapy. 2nd ed. Wadden, T.A. Raven Press, New York. p.400.

Teixeira, P.J. 2004. Who will lose weight? A reexamination of predictors of weight loss in women. *International Journal of Behavioral Nutrition and Physical Activity*, 1(1), p.12.

Tomiyama, A.J. 2019. Stress and Obesity. *Annual Review of Psychology,* 70, pp.703-718.

Tsai, A.G. and Wadden, T.A. 2005. Systematic review: an evaluation of major commercial weight loss programs in the United States. *Ann Intern Med.*, 142(1), p.56-66.

Tsigos, C. and Chrousos, G.P. 2002. Hypothalamic-pituitary-adrenal axis, neuroendocrine factors and stress. *Journal of Psychosomatic Research*, 53(4), pp.865-871.

Wadden, T.A. 1992. A multicenter evaluation of a proprietary weight reduction program for the treatment of marked obesity. *Archives of Internal Medicine*, 152(5), pp.961-966.

Wing, R.R. 2003. Behavioral interventions for obesity: recognizing our progress and future challenges. *Obesity Research*, 11 Suppl, pp.3S-6S.