ISSN: 2572-3278

Hazelton et al. J Nutri Med Diet Care 2019, 5:033
DOI: 10.23937/2572-3278.1510033
Volume 5 | Issue 1
Open Access

Journal of
Nutritional Medicine and Diet Care

ORIGINAL RESEARCH ARTICLE

Psychosocial Outcomes from an Inter-Professional Worksite Weight Loss Program

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Abstract

Background/Rationale: Management of obesity and overweight, with even modest success, can significantly ameliorate their public health burden and health care costs. Many employers recognize that obesity and the associated comorbidities decrease productivity and increase healthcare costs. They are therefore motivated to help their employees with obesity to manage their health both for financial reasons as well as for improving workplace productivity and morale. Worksite interventions have had some success in targeting weight and related comorbidities; however, there are few studies examining the psychosocial effects of inter-professional worksite interventions. Moreover, obesity is both cause and consequence of many psychosocial and behavioral problems, such as poor eating habits, poor sleep quality, depression, and low quality of life (QoL).

Methods: The current study assessed the psychosocial outcomes of an inter-professional worksite intervention that included access to exercise equipment and classes, healthy meals, the expertise of medical, nutrition, psychology staff and other health professionals as well as education related to behavioral factors that can make weight management easier. Program participants took part in a prospective, observational study using a before-after study design. The objective was to assess the psychosocial outcomes of the program at baseline, the conclusion of the intervention, and at follow-up time points.

Results: In addition to achieving similar weight loss [2.7 kg (SD ± 6.35)] as those taking part in other published weight loss interventions, these participants experienced improvements in disordered eating patterns, sleep quality, and weight-related QoL, during the program. Furthermore, binge eating and QoL improvements were sustained 1 year after conclusion of the program.

Conclusion: These findings demonstrate that short and long-term improvements in psychosocial factors can be achieved from an inter-professional worksite wellness program. These findings further support efforts that address psychosocial factors in worksite wellness programs and suggest that a focus on participant QoL may be of particular

Citation: Hazelton AG, Corsino L, Eisenson H, Østbye T, Svetkey LP, et al. (2019) Psychosocial Outcomes from an Inter-Professional Worksite Weight Loss Program. J Nutri Med Diet Care 5:033. doi.org/10.23937/2572-3278.1510033

Accepted: February 19, 2019: **Published:** February 21, 2019

importance for future evidence-based weight management programs.

Keywords

Binge eating, Disordered eating behavior, Weight loss, Sleep hygiene, Quality of life, Psychosocial, Worksite wellness, Obesity management

Introduction

Sixty-five percent of the United States population is overweight or obese [1] and full-time workers share a similar percentage at 66.5% [2,3]. Obesity is increasingly common across the industrialized world, with serious implications for health and health care costs [4]. Considering the costs to employers in health care [5,6] as well as occupational injury, lost productivity or absenteeism [7], the worksite has garnered increasing interest as a logical venue in which to develop interventions for health promotion [8]. Over the last several years, roughly half of workers have been enrolled in employer-insured health plans [9], giving employers a greater stake in employee health. Weight loss is important for employee health as obesity contributes to the development of conditions such as diabetes, hypertension and cardiovascular disease. Moreover, lower BMI is linked to lower health care costs [10].

Workplace wellness interventions can improve the health of employees [11], as well as lower health care costs for employers. A meta-analysis on costs and savings related to wellness programs at worksites found that medical costs fall by $3.27 for every $1 spent on wellness programs and that absenteeism costs fall by $2.73 for every $1 spent [12]. Key features of successful worksite weight loss interventions include opportunities for physical activity, exercise prescriptions, multicomponent health educational practices, weight loss competitions and incentives, and guidance through behavioral skills [13].

In general, worksite weight-loss interventions have been either conducted at the individual level, in which employees are given educational information and encouragement to adopt health-promoting behavior, or at the environmental level, in which modifications are made to the worksite environment to facilitate the adoption of healthy behaviors (e.g., increased availability or subsidized cost of nutritious food) [14].

A challenge to obesity management and weight control relates to the difficulties of sustaining long-term behavior change. Comprehensive, inter-professional, and behaviorally oriented interventions can significantly lower weight and improve cardiovascular fitness [15]; however, most workplace programs are not this robust, likely limiting their effectiveness. In addition, compared to weight outcomes, less is known about the psychosocial outcomes among individuals who participate in employee or worksite weight loss programs, and even less is known about how psychosocial factors may relate to weight outcomes. Importantly, weight loss maintenance and health behavior efforts have been shown to be more sustainable when psychosocial factors are addressed. Examples include enjoyment of or positive attitudes toward the behavior change, aligning health behaviors with personal values, addressing social relationships, and time management [16-18].

Among the numerous psychosocial variables that have been examined in weight management literature, binge eating, depression, sleep, and quality of life (QoL) have been found to be important. Recent estimates of the prevalence of binge eating in treatment-seeking populations are 17% [19] although prior estimates are as high as 55% [20]. Unaddressed binge eating is associated with continued weight gain and inferior outcomes in weight management [21,22], weight regain following weight loss, [23] and concomitant anxiety & depression [24]. While depression may be associated with both weight gain and weight loss, depression is a common barrier to weight loss effort among individuals with overweight and obesity. Poor sleep quality and poor sleep hygiene are also associated with difficulty in managing weight. In a metanalysis by Lasikiewicz and colleagues [25], of numerous psychosocial variables examined in weight loss studies, QoL had the strongest association with changes in weight.

The Duke Diet and Fitness Center (DFC) is a well-known inter-professional, residential weight management program that has seen remarkable success over the years. The program has been featured on programs including the national CBS News, and U.S. News & World Report, among others. The Duke Employee Weight Loss (DEWL) program utilized key aspects of Duke's residential program, creating a non-residential, accessible format for working adults. The current study assessed psychosocial outcomes of this inter-professional worksite weight loss program.

Methods

The current employee weight loss program was designed as a 4-week intensive worksite intervention combining aspects of individual-level treatment (e.g., group-based education, exercise classes, support groups) with a degree of environment-level intervention, providing increased access to physical activity and healthy dietary options in a near work facility. Following suggestions from a systematic review, this current worksite weight control program combined exercise, nutrition and educational activities [26], with this pilot program structured to provide an intensive, inter-professional therapeutic experience, and accommodating the schedules of busy employees and their family members. The Duke Employee Weight Loss (DEWL) program was designed to reduce participant weight and improve other physical and psychological variables among those with elevated

body weight. Effects on weight are reported by Corsino and colleagues [27] and describe the 1-year post-intervention weight loss averaged 2.7 kg (SD ± 6.35). In this manuscript, we assess the changes in psychosocial outcomes (binge eating, sleep quality, depression symptoms) and weight-related QoL from baseline to immediate-post treatment (4 weeks) and from baseline to follow-up (6 months and 1-year post-treatment) among participants in this pilot inter-professional worksite program.

Study design

This prospective, observational study evaluated psychosocial variables and QoL for participants enrolled in the 4-week intensive DEWL program. All participant outcomes were measured at baseline, immediately following the intervention (4 weeks), and one-year following completion of the intervention. In addition, QoL was measured 6 months post-intervention. The primary outcome was change in participant scores from baseline to immediate-post treatment (4 weeks). Secondary outcomes were changes in participant scores at additional follow-up points (6 months and/or 1 year after program completion).

Participants

Forty employee participants completed baseline assessments. These participants voluntarily provided data with an opt-in opportunity after signing up for the DEWL program described above. The DEWL program was a participant paid weight loss program. Of those 40 participants, 29 had both baseline and 1-year post-intervention follow-up data. Those who completed both baseline and 1-year follow-up maintained an average weight loss of 2.7 kg (SD = 6.35) (95% CI 0.631 to 11.28; p = 0.03) at 1 year post program completion. Select participants baseline characteristics are displayed in Table 1. A full description of medical outcomes is published elsewhere [27].

Intervention

The DEWL program took place at the Duke Diet and Fitness Center (DFC), the site of Duke's well-known interdisciplinary residential weight-loss program located in Durham, NC. Responses to the "healthy immersion" approach of the DFC program inspired investigators to create a 4-week intervention for working people modeled on the DFC's residential treatment by incorporating key elements of the residential treatment. The DEWL program fee incorporated 40 prepared low-calorie, healthy meals (10 per week), exercise classes Monday thru Thursday evenings and Sat mornings (5 per week), and supportive educational sessions following exercise classes (5 per week). Class content was drawn from the original residential program, but provided in a non-residential format. The program was intended to make seminal aspects of the interdisciplinary residential program accessible to employees and their family members (spouses, partners, and dependents over the age of 18), in daily, after-work sessions and Saturday mornings. Participants generally attended a post-work exercise class, followed by a meal during a supportive educational class (See Table 2). If participants were unable to attend the evening exercise class, they were able to exercise independently at the DFC prior to work or on the weekends.

Following the intervention period, participants were followed without further education or treatment for an additional year.

Procedure

During registration, 54 medically cleared participants of the DEWL program were invited to participate in a research study examining the outcomes of the program. Participants were eligible for the study if their Body Mass Index (BMI) was greater than or equal to 25 kg/m^2, capable of granting informed consent, and not pregnant, planning pregnancy, or breastfeeding. In addition to anthropomorphic measures completed with

Table 1: Select Baseline Characteristics Mean (SD) or Percent.

	All Participants N = 40
Demographic Variables	
Age, mean (SD)	48.2 (10.7)
Female	88.0%
African American	30.0%
Caucasian	65.0%
Hispanic	2.5%
Married/Cohabitating	55.0%
Single	18.0%
Divorced/Separated/Widowed	24.0%
Weight Status	
Overweight (BMI 25-29.9)	10.0%
Obese (BMI ≥ 30)	90.0%
Clinically Significant Psychosocial Variables	
Depression Symptoms	21.2%
Binge Eating	12.5%
Sleep Dysfunction	70.0%
Impaired Quality of Life	81.1%

Table 2: Psychoeducation Classes Provided by Various Disciplines.

Health Psychology & Coaching	**Nutrition**	**Fitness**	**Medical**
Launching Success	Myths & Realities	Fitness Fundamentals	Medical - Obesity Overview
Stress Management	Calories & Portions	Beyond the Basics	Medical Topics Part I
Overcoming Emotional Eating	Volumetrics	Beating Boredom	Medical Topics Part II
Protecting Success: Relapse Prevention	Restaurant Strategies	Progressing Your Fitness Routine	Anti-Obesity Medications & Obesity Surgery

all program participants, additional quality of life study measures were completed at baseline, immediately post-treatment (4 weeks) and at 6 months and 1-year post-treatment follow-up. Study participants also completed self-report psychosocial questionnaires at baseline, immediately post-treatment (4 weeks) and 1-year post-treatment follow-up. To thank participants for providing access to their data, 8 additional Duke Diet and Fitness Center meal vouchers were provided to those participants who completed their 1-year follow-up visit. The Institutional Review Board of Duke University Medical Center approved all aspects of the study and participants provided written informed consent.

Psychosocial measures

The Binge Eating Scale (BES); [28] is a valid [29] and reliable [30] measure of both the behavioral and emotional characteristics of binge eating. Participants are asked to select statements from each of 16 items that are most descriptive of them, with answer choices representing varying levels of symptom severity. Total scores range from 0 to 46. Symptom severity is scored as mild (≤ 17), moderate (18-26), and severe (≥ 27).

Sleep quality was assessed using the self-rated portion of the Pittsburgh Sleep Quality Index (PSQI); [31]. A well-established measure of sleep quality, the PSQI is composed of 19 self-rated items. Higher PSQI-scores represent lower quality of sleep. PSQI global or total scores range from 0 to 21. The current study focused on the global or total score. Poor sleep has been defined as a PSQI global score of ≥ 5. This cutoff has been shown to have high specificity and sensitivity for distinguishing insomnia patients and healthy controls.

The Center for Epidemiologic Studies Depression Scale (CES-D-20); [32] is a widely used, self-report measure of symptoms of depression. The range of scores on the CES-D-20 is 0-60 with higher scores indicating greater symptoms. A cutoff a score of 16 distinguishes “significant” from “mild” depressive symptomatology [33]. Items include depressed mood, feelings of guilt, worthlessness, and helplessness, psychomotor retardation, loss of appetite and sleep difficulties. Responses are based on the frequency of occurrence during the past week.

The Impact of Weight on Quality of Life-Lite questionnaire (IWQOL-Lite); [34,35] is a 31-item scale used to measure how participants view their body weight impacting their day-to-day lives. For this study, we used the total score, which ranges from 0 to 100, and this was coded with higher scores indicating greater quality of life (scores are reverse coded in some studies). Severity is based on standard deviation from a large normative sample, and these ranges are noted below. The authors of this measure have demonstrated that a 7.8 unit change in scores is considered clinically meaningful among those with low baseline impairments and 12 is clinically meaningful among those with severe baseline impairments [36]. Reliability and validity of the IWQOL-Lite have shown to be very good [35]. As higher scores have less impairment than lower scores, participants with a score of 87.1 and above represent no impairment (none), as noted below.

	None	Mild	Moderate	Severe
Total Score	≥ 87.1	79.5-87.0	71.9-79.4	< 71.9

Statistical analysis

In this prospective, observational study, each participant served as their own control and their pre-intervention status was compared to their status post-intervention. The primary outcomes were changes in psychosocial and quality of life scores from baseline to immediate post-treatment (4-weeks), and secondary outcomes were changes in psychosocial and quality of life measures from baseline to follow-up assessments (6 months and/or 1 year post-treatment) to assess longer-term outcomes. These changes over time were assessed using within-subjects, repeated measures analyses of variance (ANOVA) procedures, to evaluate the effect of program participation. Follow-up tests of simple effects were conducted using paired samples t-tests. Analyses at each time-point were performed using actual data collected; no missing variables were imputed despite inconsistently completion rates across variables and time-points. All statistical analyses were performed using SPSS (IMB SPSS Statistics Version 24).

Results

Table 3 presents descriptive statistics for baseline

Table 3: Means and Standard Deviations for Psychosocial Outcome Variables at each Time-point.

Psychosocial Measure	Baseline (pre-tx)	Immediate post-tx (4 weeks)	Follow-up 6 months post-tx	Follow-up 1 year post-tx
Binge Eating Scale (BES)	12.6 (5.32) n = 32	8.2 (6.14) n = 33	---	10.2 (7.12) n = 21
Pittsburgh Sleep Quality Index (PSQI)	6.1 (2.98) n = 40	4.2 (2.47) n = 34	---	5.7 (2.81) n = 23
Center for Epidemiological Studies - Depression (CES-D)	9.3 (7.32) n = 33	7.0 (6.94) n = 31	---	9.4 (9.45) n = 18
Impact of Weight of Quality of Life (IWOQL)	70.7 (15.85) n = 37	79.3 (16.47) n = 28	79.2 (13.72) n = 23	79.0 (12.65) n = 19

tx = Treatment.

Table 4: Simple Effects: Mean Differences on Psychosocial and Quality of Life Outcomes between Time Points.

Measure (n)	Time points	Mean Difference	p	95% CI Lower Bound	95% CI Upper Bound
Binge Eating Scale* (n = 14)	BL - Post-tx (4 wk)	-4.78	0.001	-7.36	-2.21
	BL - 1 yr follow-up	-3.64	0.018	-6.57	-0.72
Pittsburgh Sleep Quality Index* (n = 17)	BL - Post-tx (4 wk)	-2.32	0.004	-3.78	-0.85
	BL - 1 yr follow-up	-1.11	0.167	-2.72	0.51
Center for Epidemiological Studies-Depression* (n = 12)	BL - Post-tx (4 wk)	-3.50	0.057	-7.13	0.13
	BL - 1 yr follow-up	-1.83	0.607	-8.49	5.15
Impact of Weight on Quality of Life-Lite (n = 11)	BL - Post-tx (4 wk)	10.34	0.003	4.33	16.35
	BL - 6 mo follow-up	8.28	0.011	2.34	14.23
	BL - 1 yr follow-up	7.63	0.012	2.06	13.19

Negative mean differences represent improvements on (binge eating, sleep, and depression) these outcome variables; Only participants with data from all assessment points are included; BL: Baseline; tx: Treatment; wk: Weeks; mo: Months.

and follow-up measures for each variable among all participants who had data at that time point. Mean differences between time-points are presented in Table 4. These simple effects analyses include only those participants who completed measures at each of the two time points analyzed, and hence have lower sample sizes.

Binge eating symptoms (BES)

A one-way repeated measures ANOVA indicated a significant effect of program participation on binge eating symptoms, Wilks' Lambda = 0.44, $F(2,12) = 7.75$, $p = 0.07$. Pairwise comparisons indicated a reduction in binge eating symptoms between baseline and immediate post-treatment (4 weeks) and between baseline and 1-year post-treatment.

Sleep quality (PSQI)

A one-way repeated measures ANOVA indicated a significant effect of program participation on sleep quality, Wilks' Lambda = 0.61, $F(2,17) = 5.34$ $p = 0.016$. Pairwise comparisons indicated a significant improvement in sleep quality from baseline to immediate post-treatment, but no significant change was observed between baseline and 1-year post-treatment.

Depressive symptoms (CES-D)

A one-way repeated measures ANOVA did not indicate a significant effect of program participation on depressive symptoms, Wilks' Lambda = 0.70, $F(2,10) = 2.15$, $p = 0.168$. Because the omnibus test was not significant, pairwise comparisons were not necessary, and in fact, revealed no significant changes in depressive symptoms between any of the time points.

Quality of life

A one-way repeated measures ANOVA showed a significant effect of program participation on the quality of life total score, Wilks' Lambda = 0.39, $F(3,8) = 4.22$, $p = 0.046$. Pairwise comparisons indicated significant improvements in overall quality of life between baseline and immediate post-treatment, between baseline and 6-months post-treatment, and between baseline and 1-year post-treatment follow-up. In addition, the QoL improvements 1-year post-treatment significantly correlated with weight loss of program participants 1-year post-treatment, $r(18) = 0.70$, $p = 0.001$.

Discussion

The DEWL worksite weight loss program not only demonstrated expected weight loss similar to that seen in other worksite weight loss interventions [27,37] but participants experienced improvements in their binge eating behavior, quality of sleep, and QOL, by the end of the 4 week program. Perhaps more importantly, not only was significant weight loss maintained 1 year following the conclusion of the program [27], but so were the improvements in binge eating symptoms and QoL. To our knowledge, the current study is unique in demonstrating long-term (one year post-treatment) improvements in binge eating behavior and QOL for participants of a 4-week multicomponent interprofessional weight loss program.

The sustained improvements seen on the binge eating scale reflect improvement in binge eating behavior, sense of control and the distress associated with binge eating. As shown previously, evidence-based interventions used during interdisciplinary programs can specifically target binge eating [38,39]. In our program, we presented evidence-based models and suggested strategies to manage binge eating in the Overcoming Emotional Eating class. Nonetheless, we did not further intervene with patients with eating disorders. Our results suggest that the overall program improved mean levels of binge eating across the active program and these improvements were stable one year out. In terms of individual differences, however, 4 individuals had clinically significant binge eating at baseline; this number remained at 4 immediately post-treatment (4 weeks); and had only dropped to 3 individuals at the 1-year follow-up. Participants with diagnostic levels of binge eating behavior at intake would benefit from additional focus on eating disorder treatment as such behaviors are likely to be a barrier to weight loss efforts [40].

The sleep quality of participants improved immediately following the program, but these improvements were not maintained at 1 year. Sleep duration and quality have also been shown to be important targets in weight management. Per the National Sleep Foundation, those in the U.S. average about 6.6 hours per night, and among employed individuals, the mean sleep duration appears to be lower [41]. With optimal sleep being between 7 and 9 hours per night, sleep duration that is consistently less than about 6 hours per night has been associated with higher BMI [42]. Greater focus on sleep hygiene may, therefore, be needed in worksite and other weight loss programs. For those participants reporting significant sleep quality issues at baseline, it may also be worth considering cognitive behavioral therapy (CBT) to improve sleep quality and duration [43] or the provision of well-studied online CBT for insomnia such as Shut-i [44]. In our study, those who were categorized as poor sleepers (PSQI ≥ 5) included approximately 70% (28/40) at baseline compared to 47.1% (16/34) immediately post-treatment, and 52.2% (12/23) at 1-year post-treatment follow-up. The decrease in the number of "poor sleepers" across the study makes sense; Alfaris and colleagues [45] found that by losing greater than approximately 5% of weight from start of intervention was associated with short-term improvements in sleep duration and sleep quality, however, these improvements were not maintained long-term in their study either.

Patients enrolled in this worksite program reported minimal depressive symptoms, as evidenced by their baseline mean of 9.3 on the CESD, indicating mean symptom level in the non-significant range. As such, there was little room for improvement. At baseline, 7 of 33 participants reported scores indicative of clinically significant depression. Only 3 of 31 participants reported depression immediately following the 4-week treatment period, and 3 of 18 reported significant depression a year later. Similar to the pattern observed on sleep measures, mean scores at 1-year follow-up were similar to where they started at baseline. Change in depression symptoms was not clinically significant and returned to a mean level approximating baseline.

It is notable that the QOL of participants significantly improved and that these improvements were sustained one year following the program. Many worksite programs are, at least in part, aimed at improving employee morale [46]. Not surprisingly, there was a highly significant correlation between the improvements in quality of life and the weight loss of program participants from baseline to 1-year post-treatment.

Program design and methodology considerations for futures studies

The worksite wellness model is promising because employees spend a large part of their day at work, and because both employees and employers have the incentive to improve employee health. For employees, worksite interventions offer convenient access to health-promotion programs for achieving their personal health-related goals and improving well-being [26]. Employers may benefit financially, as obese workers have twice the number of workers' compensation claims, 10 times the number of lost workdays, and 8 times the medical claims costs of non-obese workers [6].

The logistical challenges of providing this level of programming included arranging staff coverage to facilitate group exercise and educational classes in the evening hours to accommodate employee work schedules. Limited staff availability made it difficult to recruit participants to the program, requiring implementation of the DEWL program for several different cohorts to achieve the pilot sample size. Unfortunately, the various instructors were not consistent in capturing attendance to classes, so it is unclear as to the dose each participant received of this program. Moreover, the mechanism of improvement in binge eating and QoL is unclear from this pilot study; the improvements could be due to the interprofessional components of the program or to the benefits of weight loss alone. Conversely, however, it is possible that addressing the psychosocial factors led to the enhancements in participant weight loss.

Regardless, our findings suggest that psychosocial variables can be modified through worksite weight loss programs with fairly simple psychoeducational, nutritional, physical activity and medical components. Thus, these psychosocial variables should be routinely considered and assessed in weight management interventions. Future studies should explore whether improvements in psychosocial variables are causal or secondary to weight loss, and how the educational and supportive elements of the program contribute to psychosocial benefits. The next step for research would be to 1) Test effects of individual program components on weight loss, and possibly 2) To test even more targeted treatments for binge eating, sleep, mood, or QOL to see if this would enhance immediate and long-term weight loss success. Worksites might use the current evidence to expand programs to address the role of disordered eating, sleep patterns, and quality of life on participant success in their programs. Anecdotally, the current model was well received by participants, and objectively the program was effective; the program therefore might work well in settings where interprofessional weight management programs are already available and could be easily be opened to employees, such as hospitals and or larger outpatient medical centers.

Acknowledgments

The investigators gratefully acknowledge the valuable contributions of the study participants and research staff members, including Sofia Rydin-Gray, PhD, Marit Weikel, MA, Janna Fikkan, PhD, Meredith Nahm,

PhD, Sandra Houlihan, NP, Crystal Tyson, MD, Ronald Sha, MD, Nate Reynolds, Caroline Crocker, Gerald K Endress, Dina Lumia, Genise Fowler, Elisabetta Politi.

For R.Q.W., most work on this paper was conducted while at Duke Diet & Fitness Center and the Duke Department of Psychiatry and Behavioral Sciences at Duke University School of Medicine.

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