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Obesity

High-Frequency Binge Eating Predicts Weight Gain Among Veterans Receiving Behavioral Weight Loss Treatments

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Objective: To assess for the frequency of binge eating behavior and its association with weight loss in an overweight/obese sample of veterans.
Methods: This study is a secondary analysis of data from the ASPIRE study, a randomized effectiveness trial of weight loss among veterans. Of the 481 enrolled veterans with overweight/obesity, binge eating frequency was obtained by survey for 392 (82%).
Results: The majority (77.6%) reported binge eating, and 6.1% reported high-frequency binge eating. Those reporting any binge eating lost 1.4% of body weight, decreased waist circumference by 2.0 cm, and had significantly worse outcomes than those reporting never binge eating who lost about double the weight (2.7%) and reduced waist circumference by twice as much (4.2 cm). The high-frequency binge group gained 1.4% of body weight and increased waist circumference by 0.3 cm.
Conclusions: High rates of binge eating were observed in an overweight/obese sample of veterans enrolled in weight loss treatment. The presence of binge eating predicted poorer weight loss outcomes. Furthermore, high-frequency binge eating was associated with weight gain. These findings have operational and policy implications for developing effective strategies to address binge eating in the context of behavioral weight loss programs for veterans.

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Introduction

Obesity is one of the most serious public health problems faced by our nation. While two-thirds of Americans are overweight/obese (1), the prevalence of overweight and obesity is greater among certain high-risk patient populations including the patients served by the veterans health administration (VHA); nearly 77% of veterans are classified as overweight/obese (2). While binge eating disorder (BED) is closely associated with obesity and is the most common eating disorder in the United States, it is understudied among veterans (3-5).

In 2013, BED was included in the revision of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (6) as a clinical disorder. Specifically, BED is defined as eating unusually large amounts of food, while experiencing a subjective sense of loss of control, on average at least once a week for 3 months or more. BED is strongly associated with high rates of psychiatric and medical comorbidity, confers a greater risk for obesity-related illnesses beyond that conferred by obesity alone (7), and affects ~30% of individuals from the general population who seek weight loss treatment and who are predominately female (8).

Individuals who binge eat may be an especially vulnerable subgroup of the overweight population, regardless of whether or not they meet DSM-5 diagnostic criteria for BED. This is best exemplified by a national study of over 45,000 veterans in which individuals reporting binge behavior were significantly more likely to report a broad range of comorbid mental health and medical conditions than those who reported no binge eating (9). While little is known about the prevalence of BED among veterans using DSM-5 diagnostic criteria, as many as 78% of veterans affected by overweight/obesity and eligible for the VHA's national weight management program, MOVE!®, report binge eating (9).

A number of psychological treatments for BED have demonstrated robust effects for reducing and/or eliminating binge eating, and

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improving the behavioral and psychological aspects of the disorder. Despite these significant improvements in binge eating and associated behaviors, there is a minimal effect on weight loss (10). Clinical trials have reported only modest associations between binge remission and weight loss (10-12), and it has yet to be determined why substantial reductions in binge eating behavior are generally associated with only minimal reductions in weight (13).

Little has been done to examine binge eating as a predictor of weight loss treatment (14-17). A negative association has been found between the presence of BED and weight loss in Latino/as (15), and among individuals with overweight/obesity and type 2 diabetes participating in the Look AHEAD study (Action for Health in Diabetes) (16). However, in a third study of patients with overweight/obesity in primary care, the presence of BED status was not associated with weight loss outcomes, but was associated with behavioral treatment adherence (17).

Given that overweight/obesity are the most prevalent medical conditions among veterans and new evidence suggesting potentially high rates of binge eating in this high-risk group (9,18), we sought to investigate rates of binge eating among veterans who were seeking weight loss treatment, and to determine whether weight outcome differed by binge eating status.

Methods

Study design

This is a secondary data analysis comparing weight loss and clinical outcomes based on binge eating status among veterans who are overweight/obese. Participant data were obtained from the ASPIRE-VA trial (19,20), a randomized clinical effectiveness trial of 481 veterans recruited for routine weight management. The trial was designed to evaluate the effectiveness of a small changes weight loss intervention, ASPIRE, compared to the VHA national weight management program, MOVE! ASPIRE encourages participants to make small, self-selected goals resulting in an energy deficit as small as 200 kcal/day that may be sufficient to promote weight loss and maintenance over time (19). MOVE!, the "usual care" weight management available to veterans served by VHA, was based upon evidence-based guidelines from the National Institutes of Health and the 2003 US Preventive Services Task Force. MOVE! utilizes an open-group format (i.e., patients can join the group at any time), on-line materials, and multidisciplinary team of health psychologists, dietitians, and physical therapists. For both ASPIRE and MOVE!, 3 months of weekly treatment was followed by 9 months of maintenance (sessions occurring biweekly for six months and then monthly).

Participants from two VHA sites were randomized to one of three treatment arms and stratified by site: (1) the ASPIRE weight loss program delivered individually over the phone (ASPIRE-Phone); (2) the ASPIRE weight loss program delivered via in-person group sessions (ASPIRE-Group); or (3) MOVE! the VHA's national weight management program, delivered as usual care. Institutional review board approval was obtained at both sites.

Participants and procedures

Eligible veterans were primary care provider- or self-referred for weight management services and eligible for MOVE! treatment at two Midwestern VA medical centers. Candidates were invited to participate if they had a BMI $\geq$ 30 kg/m^2, or between 25 and 30 kg/m^2 and at least one obesity-related health condition (e.g., type 2 diabetes). Other inclusion criteria included an ability to communicate in English and ability to provide informed consent, as well as reliable access to a telephone. Exclusionary criteria were as follows: current enrollment in another weight loss, nutrition, or physical activity study; current involvement in another weight loss treatment or medication; inability to complete a 6-min walking test; or pregnancy. An additional study criterion included completion of a binge eating frequency item (described below) to determine binge status. Of the 481 participants randomized to ASPIRE, the effective sample size for this study was $N = 392$ as binge eating status information was missing for 89 original cohort participants. There were no significant differences in demography, or clinical characteristics, between those with and without the binge eating status information. Enrollment began January 2010 and all 12-month follow-up assessments were completed by November 2012.

Binge status and measures

Prior to randomization, participants completed the MOVE!23 Survey, a clinical instrument developed to aid in tailoring weight management treatment for veterans by administering the survey prior to engaging in MOVE! and evaluating each individual's unique treatment needs (21). The 23-item questionnaire assesses a number of domains related to weight management; however, because it is not a research instrument, limited psychometric validation has been conducted (22). Only the binge eating behavior item from the MOVE!23 Survey was used for this study. This is a self-report item that asks, "On average, how often have you eaten extremely large amounts of food at one time and felt that your eating was out of control at that time?" The response set for this item is *never*, *less than one time per week*, *one time per week*, *two to four times per week*, or *five or more times per week*. At baseline, demographic and clinical data were obtained for descriptive purposes. Psychiatric (post-traumatic stress disorder (PTSD) and substance use) disorders and medical diagnoses were obtained from medical records to compute the Charlson Comorbidity Index (CCI). The CCI is a validated measure indicating burden of disease based upon age and presence of 19 conditions with high likelihood of mortality (23). The Satisfaction with Life Scale (24) was also administered as part of the baseline assessment survey.

We chose two *a priori* methods for categorizing participant binge eating status. In the first method, we categorized participants using a previously reported strategy that distinguished veterans with high rates of psychiatric and medical comorbidities using the MOVE!23 binge frequency item (9). Those who responded "never" to the MOVE!23 binge frequency item were categorized as NO BINGE, and those who reported "less than one time per week" or more were categorized as ANY BINGE. The second method was based upon previously published studies where the mean frequency of binge eating behavior was approximately 4.5 episodes per week among patients meeting DSM-5 criteria for BED and seeking weight loss treatment (23,24). Thus, in the second method, participants who reported "five or more times per week" were categorized as HIGH BINGE and all others were categorized as NOT HIGH.

The primary outcome for this study was percent weight loss, both continuously and categorically (i.e., attainment of 5% weight loss).

TABLE 1 Frequency of binge eating from the MOVE!23 Survey ($N = 392$)

Frequency	*n*	%
Never (*NO BINGE*)	88	22.4
Less than 1 time per week	117	29.9
1 time per week	62	15.9
2–4 times per week	101	25.8
5 or more times per week (*HIGH BINGE*)	24	6.1

For descriptive purposes, results were also presented for weight (kg), BMI [weight (kg)/height (m^2)], and waist circumference (cm). Exploratory analyses were performed for secondary outcomes including dietary outcomes as measured by the self-reported Food Frequency Questionnaire (25), and metabolic outcomes as measured by lipid profile analysis and blood pressure. Measures were assessed at three time points; participants received remuneration for completing assessments at baseline ($20), 3 months ($20), and 12 months ($50).

Statistical analyses

Descriptive statistics were calculated for all variables using Pearson Chi-square test for categorical variables and analysis of variance for continuous variables. One-sided linear mixed models were used to model the longitudinal change in outcomes at 3 and 12 months post-randomization. Two separate models were built for each of the *a priori* set of binge eating categories with either NO BINGE or NOT HIGH as the reference group. The following independent variables were controlled for in the models: treatment arm, baseline value of the outcome variable, binge eating status, time, and time by binge eating status interaction. It is important to note that given that the main focus of this study was to examine treatment outcome by binge status, participants were pooled together across treatment arms and treatment arm was controlled for in analyses. Finally, chi-square analyses were conducted to examine whether those in the lower binge status groups were more likely to achieve 5% or greater weight loss compared to the high binge status groups, and more likely to complete treatment. All analyses were performed in Stata, version 13.1 (College Station, TX).

Results

Demographic clinical and treatment characteristics, and binge frequency

The sample was predominately middle aged (M = 55.4, SD = 10.0), moderately obese (M BMI = 36.4, SD = 6.1) men ($n = 333$, 84.9%) composed of 57.7% ($n = 226$) White, 40.3% ($n = 158$) African American, and 2% ($n = 8$) "other" race. With regard to weight status, 10.7% ($n = 42$) were overweight and 89.2% ($n = 350$) were obese. In terms of randomization, 128 (32.7%) were assigned to ASPIRE-Phone, 132 (33.7%) to ASPIRE-Group, and 132 (33.7%) to MOVE! Participants completed an average of 12.8 (SD = 9.3) sessions and there was a significant difference in sessions completed by treatment arm. Specifically, participants in both the ASPIRE-Phone (M = 15.2) and ASPIRE-Group (M = 12.9) attended significantly more sessions compared with MOVE! (M = 5.5). For the overall sample, rates of PTSD and substance use disorders were 16.8 and 17.1%, respectively, the mean CCI was 1.2 comorbid conditions (SD = 1.5, range 0-9), and mean life satisfaction was 3.8 (SD = 1.5, range 1-7).

Overall, 77.6% ($n = 304$) of participants reported any binge eating, with almost half (47.7%; $n = 187$) reporting binge eating one or more times per week and 6.1% ($n = 24$) reporting five or more times per week (see Table 1).

The NO BINGE group had a significantly lower mean baseline weight and BMI compared to the ANY BINGE group (P's < 0.05) and had a significantly smaller proportion of participants with PTSD (8 vs. 19.4%, $P = 0.01$), whereas the NOT HIGH and HIGH BINGE groups did not differ on baseline weight or BMI, or presence of PTSD. The NOT HIGH group reported significantly greater life satisfaction than the HIGH BINGE group ($P = 0.03$). No significant differences were found between sex, age, race, presence of substance use disorders, or CCI on either binge status comparison (i.e., NO BINGE vs. ANY BINGE, or NOT HIGH vs. HIGH BINGE). See Tables 2 and 3 for comparisons of baseline demographic and clinical characteristics.

Comparisons by binge status

There were significant differences on the primary percent weight loss outcome by binge status. The NO BINGE group had significantly greater mean percent weight loss and significantly greater mean reduction in waist circumference than the ANY BINGE group. At 12 months the NO BINGE group lost 2.7% of body weight and waist circumference decreased by 4.2 cm, whereas the ANY BINGE group lost 1.4% of body weight and waist circumference decreased by 2.0 cm ($P = 0.029$ and $P = 0.008$, respectively). Differences in weight change (kg) and BMI approached significance ($P = 0.054$ and $P = 0.056$, respectively). These findings held even when controlling for PTSD status. Figure 1 depicts the weight changes (kg) from baseline to 12 months post-treatment for the NO BINGE and ANY BINGE groups. No significant differences between the NO BINGE and ANY BINGE groups were observed for the secondary dietary and metabolic outcomes. See Table 4 for comparison of the NO BINGE and ANY BINGE groups.

There were significant differences on the primary percent weight loss outcome and all other weight outcomes using the second categorization method as well. The NOT HIGH group had significantly greater mean percent weight loss, and greater reductions in weight (kg), BMI, and waist circumference than the HIGH BINGE group. At 12 months the HIGH BINGE group gained 1.4% of body weight and waist circumference increased by 0.3 cm, whereas the NOT HIGH group lost 1.9% of body weight and waist circumference decreased by 2.7 cm ($P = 0.001$ and $P = 0.029$, respectively). Figure 2 depicts the weight changes (kg) from baseline to 12 months post-treatment for the NOT HIGH and HIGH BINGE groups. There were no significant differences between the NOT HIGH and HIGH BINGE groups on secondary measures for dietary and metabolic outcomes. See Table 5 for comparisons of the NOT HIGH and HIGH BINGE groups.

Five percent weight loss

Overall, 21.6% ($n = 75$) of the 348 participants with post-treatment weight data achieved clinically significant weight loss (i.e., at least 5% weight loss). Participants in the NO BINGE group were not

TABLE 2 Demographic and clinical characteristics of the total sample by NO BINGE and ANY BINGE status ($N = 392$)

	NO BINGE		ANY BINGE		Total		*P*-value
n	88		304		392		
Sex (male), *n* (%)	76	(86.4)	257	(84.5)	333	(84.9)	0.673
Age category (years), *n* (%)							0.676
<50	24	(27.3)	75	(24.7)	99	(25.3)	
50-59	31	(35.2)	99	(32.6)	130	(33.2)	
60+	33	(37.5)	130	(42.8)	163	(41.6)	
Race, *n* (%)							0.344
African-American	41	(46.6)	117	(38.5)	158	(40.3)	
Other	1	(1.1)	7	(2.3)	8	(2.0)	
White	46	(52.3)	180	(59.2)	226	(57.7)	
Baseline weight (kg), mean (SD)	107.2	(18.2)	114.1	(23.6)	112.6	(22.7)	0.012
Baseline BMI, mean (SD)	34.8	(4.7)	36.9	(6.4)	36.4	(6.1)	0.004
Baseline BMI category							0.016
>25-29.9	15	(17.0)	27	(8.9)	42	(10.7)	
≥30-39.9	59	(67.0)	192	(63.2)	251	(64.0)	
≥40	14	(15.9)	85	(28.0)	99	(25.3)	
PTSD, *n* (%)	7	(8.0)	59	(19.4)	66	(16.8)	0.011
Substance use disorder, *n* (%)	16	(18.2)	51	(16.8)	67	(17.1)	0.767
Charlson Comorbidity Index, mean (SD)	1.0	(1.3)	1.2	(1.6)	1.2	(1.5)	0.263
Life Satisfaction, mean (SD)	3.9	(1.5)	3.8	(1.5)	3.8	(1.5)	0.521

significantly more likely to achieve 5% weight loss compared with the ANY BINGE group [25.6% (20/78) vs. 20.4% (55/270); χ^2 (1) = 0.99, $P = 0.319$]. However, participants in the NOT HIGH group were significantly more likely to achieve 5% weight loss compared with the HIGH BINGE group [22.8% (74/325) vs. 4.4% (1/23); $\chi^2(1) = 4.31$, $P = 0.038$].

TABLE 3 Demographic and clinical characteristics of the total sample by NOT HIGH and HIGH BINGE status ($N = 392$)

	NOT HIGH		HIGH BINGE		Total		*P*-value
n	368		24		392		
Sex (male), *n* (%)	315	(85.6)	18	(75.0)	333	(84.9)	0.159
Age category (years), *n* (%)							0.614
<50	93	(25.3)	6	(25.0)	99	(25.3)	
50–59	120	(32.6)	10	(41.7)	130	(33.2)	
60+	155	(42.1)	8	(33.3)	163	(41.6)	
Race, *n* (%)							0.713
African-American	149	(40.5)	9	(37.5)	158	(40.3)	
Other	8	(2.2)	0	(0.0)	8	(2.0)	
White	211	(57.3)	15	(62.5)	226	(57.7)	
Baseline weight (kg), mean (SD)	112.4	(22.6)	114.9	(23.5)	112.6	(22.7)	0.610
Baseline BMI, mean (SD)	36.3	(6.0)	38.7	(7.7)	36.4	(6.1)	0.056
Baseline BMI category							0.360
>25–29.9	40	(10.9)	2	(8.3)	42	(10.7)	
≥30–39.9	238	(64.7)	13	(54.2)	251	(64.0)	
≥40	90	(24.5)	9	(37.5)	99	(25.3)	
PTSD, *n* (%)	62	(16.8)	4	(16.7)	66	(16.8)	0.982
Substance use disorder, *n* (%)	61	(16.6)	6	(25.0)	67	(17.1)	0.291
Charlson Comorbidity Index, mean (SD)	1.2	(1.5)	0.8	(1.3)	1.2	(1.5)	0.275
Life Satisfaction, mean (SD)	3.8	(1.5)	3.2	(1.3)	3.8	(1.5)	0.027

NOT HIGH = less than five binge episodes per week; HIGH BINGE = greater or equal to five binge episodes per week.

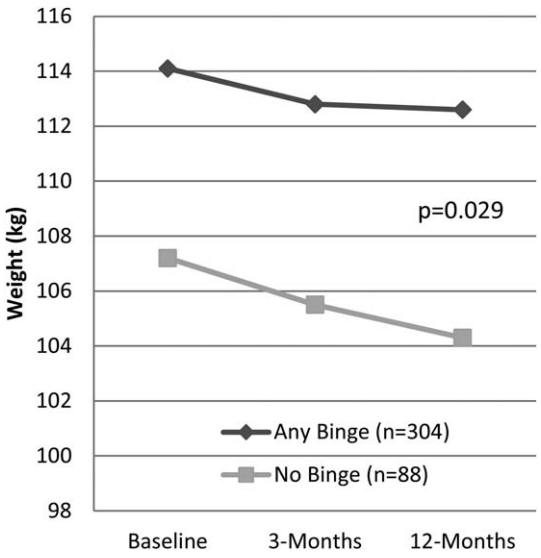

Figure 1 Predicted weight change at 3 and 12 months for veterans classified as NO BINGE or ANY BINGE based on linear mixed effects models controlling for treatment arm, baseline weight, binge eating status [NO BINGE vs. ANY BINGE], visit, and visit by binge eating status interaction.

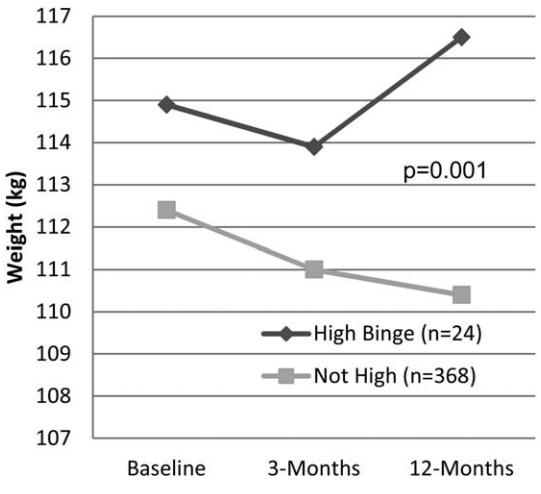

Figure 2 Predicted weight change at 3 and 12 months for veterans classified as NOT HIGH or HIGH BINGE based on linear mixed effects models controlling for treatment arm, baseline weight, binge eating status [NOT HIGH vs. HIGH BINGE], visit, and visit by binge eating status interaction.

Treatment completion

Overall, 88.8% ($n = 348$) of the 392 randomized participants completed the 12-month post-treatment weight assessment, including the measurement of weight. Participants in the NO BINGE group were not significantly more likely to complete treatment compared with the ANY BINGE group [88.6% (78/88) vs. 88.8% (270/304); $\chi^2(1) = 0.00$, $P = 0.963$]. Participants in the NOT HIGH group were also not significantly more likely to complete treatment compared with the HIGH BINGE group [88.3% (325/368) vs. 95.8% (23/24); $\chi^2(1) = 1.28$, $P = 0.258$]. There were no significant differences between binge eating status groups for the number of treatment sessions attended (NO BINGE = 12.2, SD = 9.1 vs. ANY

TABLE 4 Adjusted comparison of various outcomes for NO BINGE ($n = 88$) and ANY BINGE ($n = 304$) groups

	Baseline[a]			12-month change[b]		
Outcome	NO BINGE	ANY BINGE	*P*-value	NO BINGE	ANY BINGE	*P*-value
Primary outcome						
% Weight loss	0.0	0.0		−2.7 (−3.8, −0.8)	−1.4 (−2.0, −0.8)	0.029
Secondary weight outcomes						
Weight (kg)	108 (104, 112)	115 (112, 117)	0.002	−2.9 (−4.0, −0.9)	−1.6 (−2.2, −0.9)	0.054
BMI (kg/m^2)	34.9 (33.9, 35.9)	37.0 (36.3, 37.7)	0.001	−0.9 (−1.3, −0.3)	−0.5 (−0.7, −0.3)	0.056
Waist (cm)	118 (115, 120)	121 (119, 122)	0.054	−4.2 (−5.6, −1.3)	−2.0 (−2.8, −1.3)	0.008
Secondary dietary outcomes						
Fruit/veg (servings)	4.6 (4.2, 5.1)	4.5 (4.3, 4.7)	0.686	0.1 (−0.3, 0.6)	0.3 (0.1, 0.6)	0.307
% Fat (g)	35.1 (34.1, 36.1)	35.0 (34.4, 35.6)	0.876	−0.8 (−2.0, −0.5)	−1.1 (−1.7, −0.5)	0.691
Fiber (g)	20.3 (18.1, 22.6)	20.4 (19.3, 21.4)	0.975	2.7 (−0.4, 1.7)	0.2 (−1.3, 1.7)	0.150
Secondary metabolic outcomes						
LDL (mg/dl)	109 (101, 117)	108 (105, 112)	0.917	−3.4 (−9.3, 1.1)	−2.0 (−5.1, 1.1)	0.698
HDL (mg/dl)	38 (36, 40)	38 (37, 39)	0.903	2.3 (0.6, 3.3)	2.5 (1.6, 3.3)	0.856
Triglycerides (mg/dl)	157 (137, 177)	167 (154, 179)	0.386	−11.4 (−32.7, 8.5)	−2.5 (−13.6, 8.5)	0.471
Hemoglobin (A1c) HbA1c	6.4 (6.2, 6.6)	6.5 (6.3, 6.6)	0.423	−0.0 (−0.2, 0.0)	−0.1 (−0.2, 0.0)	0.538
Systolic (mm Hg)	125 (122, 128)	128 (126, 130)	0.069	−0.8 (−4.0, 3.1)	1.4 (−0.3, 3.1)	0.223
Diastolic (mm Hg)	77 (75, 80)	79 (78, 80)	0.268	0.3 (−1.7, 1.2)	0.1 (−0.9, 1.2)	0.884

[a]Unadjusted means at baseline.
[b]Predicted 12-month changes for each outcome variable based on linear mixed models. Independent variables included time (3 or 12 months), treatment arm, baseline value of the outcome variable, binge eating status [NO BINGE (reference) vs. ANY BINGE], time, and time by binge eating status interaction.

TABLE 5 Adjusted comparison of various outcomes for NOT HIGH ($n = 368$) and HIGH BINGE ($n = 24$) groups

	Baseline[a]			12-month change[b]		
Outcome	NOT HIGH	HIGH BINGE	*P*-value	NOT HIGH	HIGH BINGE	*P*-value
Primary outcome						
% Weight loss	0.0	0.0		−1.9 (−2.4, −1.4)	1.4 (−0.5, 3.3)	0.001
Secondary weight outcomes						
Weight (kg)	113 (111, 115)	113 (104, 122)	0.957	−2.1 (−2.7, −1.5)	1.6 (−0.6, 3.7)	0.001
BMI (kg/m^2)	36.4 (35.8, 37.0)	37.9 (34.8, 40.9)	0.328	−0.7 (−0.9, −0.5)	0.5 (−0.2, 1.2)	0.001
Waist (cm)	112 (118, 121)	121 (114, 129)	0.666	−2.7 (−3.4, −2.0)	0.3 (−2.3, 3.0)	0.029
Secondary dietary outcomes						
Fruit/veg (servings)	4.6 (4.4, 4.8)	4.5 (3.7, 5.2)	0.785	0.3 (0.1, 0.5)	0.2 (−0.6, 1.0)	0.833
% Fat (g)	34.9 (34.4, 35.4)	36.6 (33.8, 39.4)	0.233	−1.0 (−1.6, −0.4)	−1.8 (−3.8, 0.2)	0.449
Fiber (g)	20.4 (19.4, 21.4)	20.0 (16.2, 23.7)	0.834	0.8 (−0.6, 2.2)	−1.3 (−6.4, 3.8)	0.434
Secondary metabolic outcomes						
LDL (mg/dl)	108 (105, 111)	118 (105, 130)	0.131	−2.1 (−5.0, 0.7)	−5.7 (−16.8, 5.3)	0.536
HDL (mg/dl)	38.3 (37.3, 39.4)	36.8 (32.7, 40.9)	0.454	2.5 (1.7, 3.3)	2.1 (−0.9, 5.1)	0.829
Triglycerides (mg/dl)	165 (154, 176)	160 (112, 207)	0.829	−5.4 (−15.5, 4.7)	11.1 (−27.9, 50.1)	0.424
Hemoglobin (A1c) HbA1c	6.4 (6.3, 6.6)	6.8 (6.1, 7.5)	0.289	−0.1 (−0.1, 0.0)	−0.2 (−0.5, 0.2)	0.564
Systolic (mm Hg)	128 (126, 129)	118 (112,123)	0.001	0.7 (−0.8, 2.3)	3.4 (−2.4, 9.3)	0.385
Diastolic (mm Hg)	79 (78, 80)	73 (68, 77)	0.008	0.0 (−1.0, 1.0)	2.2 (−1.4, 5.9)	0.249

NOT HIGH = less than five binge episodes per week; HIGH BINGE = greater or equal to five binge episodes per week.
[a]Unadjusted means at baseline.
[b]Predicted 12-month changes for each outcome variable based on linear mixed models. Independent variables included time (3 or 12 months), treatment arm, baseline value of the outcome variable, binge eating status [NOT HIGH (reference) vs. HIGH BINGE], time, and time by binge eating status interaction.

BINGE = 12.9, SD = 9.4, $t = -0.63$, $P = 0.53$; NOT HIGH = 13.0, SD = 9.3 vs. HIGH BINGE = 10.0, SD = 9.3, $t = 1.53$, $P = 0.13$).

Discussion

This is the first study to investigate the potential negative implications of binge eating among veterans seeking weight loss treatment through the VHA. Overall, high rates of self-reported binge eating episodes were observed in this sample of veterans with overweight/obesity who enrolled in a clinical trial of weight loss. Over three-quarters (78%) reported any binge eating, 72% reported less than one time per week to four times per week, and 6% reported high-frequency binge eating (five or more times per week) similar to patients with DSM-5 diagnosed BED who enrolled in clinical trials for weight loss and binge eating treatments (26,27).

Additionally, binge eating, particularly high-frequency binge eating, predicted worse weight outcomes. Those without binge eating lost almost twice as much weight and reduced their waist size by more than double compared to those with any binge eating after 12 months. The much higher rate of PTSD in the any binge group did not account for the differences in weight. Even more striking were findings for those reporting high-frequency binge eating. Those individuals on average *gained* weight and waist circumference *increased*. Nearly one-quarter of the no/low-frequency binge group participants achieved clinically significant weight loss (i.e., at least 5% of body weight), whereas only 4% of the high-frequency binge group did so. Despite the disparate weight outcomes, veterans completed treatment at similar rates, and attended a similar number of sessions, regardless of binge status.

These findings have important implications because evidence for the negative implications of binge eating on weight loss, even amongst individuals with BED, is poorly understood (28). Consistent with studies examining the prognostic significance of BED in predominately female samples (14-16), we found that binge eating was a negative prognostic indicator for weight loss. Contrary to studies that found greater attrition (29) and lower treatment adherence (17), however, we did not find that binge eating predicted higher attrition or lower session attendance among veterans in this study.

The most notable limitation of this study was the assessment of binge eating frequency with a single self-report item. It is not known whether this item is reliable, or how valid the categorical response set is compared to state-of-the-art measures, such as the clinician administered Eating Disorder Examination (30) or the self-report version, the Eating Disorder Examination-Questionnaire (EDE-Q) (31), which utilize continuous data for measuring binge episodes. While a severity specifier for BED was added to DSM-5 (6) (e.g., mild is 1–3 binge eating episodes per week), we know of no study that has validated these categories. Thus, it is noteworthy that the binge assessment used here identified two potentially important subgroups of veterans with overweight/obesity. One subgroup, the any binge eaters, was less successful at weight loss, and a second subgroup, the high-frequency binge eaters, actually gained weight during the course of weight management treatment.

Participants in this study were mostly older male veterans who were overweight/obese and who participated in a weight loss clinical trial through the VHA in two Midwestern states. Findings may not generalize to non-veterans, or veterans who: are overweight/obese

and not obtaining weight loss treatment or who obtain weight loss treatment outside of a research study; do not seek care through the VHA; are from other parts of the country; are female or younger. Another concern in this study was the clinical meaningfulness of the low weight losses observed. This, combined with the short time frame of the entire study (12 months), may have accounted for the absence of significant dietary and metabolic improvements. On the other hand, a 5–10% weight loss has clinically meaningful health benefits and while only 4% of HIGH BINGE veterans achieved this, 20–25% of all other veterans lost at least 5% of body weight. A final limitation was the potentially insufficient sample size ($n = 24$) in the HIGH BINGE category to detect differences in some outcomes.

Our findings have immediate and important policy implications for the assessment of binge eating behavior among veterans. The binge item discriminates amongst veterans who will be successful in weight management treatment, is easily disseminated (self-report and low burden), and has been retained in the newest condensed version of the MOVE!23 Survey (MOVE!11). There are also important research implications. Replication, particularly with a larger sample size, is needed. The first step in remedying the disparities in weight loss outcome will be to test treatments for BED in the VHA system. Treatment completion findings from this study suggest that binge eating veterans will likely engage in treatment.

One question raised by these findings is whether MOVE! is contraindicated for veterans with high-frequency binge eating because they gained weight. An alternative view is that treatment helped to slow the rate of weight gain for those binge eaters who would thus have fared worse without treatment. Like previous research reporting steep weight gain trajectories prior to MOVE! participation (32,33), we found that on average, ASPIRE study participants had gained 2.9 kg (95% CI: 1.7, 4.2) in the 12 months prior to study initiation. Interestingly, there were no significant differences in pretreatment weight trajectories between the binge groups in this study, in contrast to a new study that found significantly greater weight trajectories in primary care patients with overweight/obesity who were seeking weight loss treatment and met DSM-5 criteria for BED, compared to those who did not (34). Regardless, it is possible that weight gain was attenuated during MOVE! participation with the any binge group losing 1.6 kg and the high binge group gaining only 1.6 kg, compared to a pretreatment weight gain of 2.9 kg.

In summary, this is the first study to demonstrate that binge eating behavior predicts poor weight loss outcome, but not poor retention, among veterans with overweight/obesity participating in a weight loss treatment study. It also demonstrated that the single, self-report MOVE!23 binge eating frequency item was successful in identifying two important subgroups of the Veteran population. One group, the *any* binge eaters, represented over three-quarters of this population, and was less successful at weight loss than those without binge eating. The second group, the high-frequency binge eaters, was the most vulnerable subgroup. Although they comprised only 6% of the Veteran population who is overweight/obese, this group actually gained weight during the course of weight management treatment. Collectively, these findings highlight the need for specific interventions to address binge eating in veterans, particularly high-frequency binge eating. Finally, there are important implications for operational implementation of MOVE! and other weight loss programs as well as for national VHA policy. Consideration should be given to strategies that specifically address BED within the context of weight loss programs. Medical teams providing primary care in VHA may benefit from understanding this subpopulation of patients with overweight/obesity. The policy implications stemming from this research may lead to national treatment expertise among clinicians. O

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