

## ORIGINAL RESEARCH ARTICLE

# Nocturnal eating but not binge eating disorder is related to less 12 months' weight loss in men and women with severe obesity: A retrospective cohort study

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## Summary

There is a paucity of studies on the frequency of binge-eating disorder (BED) and nocturnal eating (NE) and their potential role as barriers in non-surgical weight loss treatment in subjects with severe obesity (body mass index [BMI]  $\geq 35$  kg m<sup>2</sup>). The aim was to identify BED and NE, and their effect on weight loss treatment. In total, 1132 (727 women, 405 men), BMI  $\sim 41$  kg/m<sup>2</sup> were patients in a 12-month weight loss programme at a specialist clinic. The questionnaire for eating and weight patterns-revised was completed by the patients before start of treatment. BED was diagnosed in 5.1% of men and 12.4% of women. NE prevalence was 13.5% and 12.7%, respectively. Mean ( $\pm$ SEM) 12-month weight loss was less in patients with NE compared to those without ( $-11.0 \pm 1.5$  vs  $-14.6 \pm 0.7$  kg,  $P = .008$ ) but did not differ in patients with and without BED, ( $-12.3 \pm 1.9$  vs  $-14.2 \pm 0.6$  kg,  $P = .24$ ). Factors associated with dropout were BED (odds ratio, OR 1.57, 95% confidence interval (CI) 1.14-2.17;  $P = .006$ ) and previous weight loss attempts (OR 1.35, 95% CI 1.0-1.7;  $P = .02$ ). BED did not seem to hinder weight loss whereas NE resulted in less weight loss in patients with severe obesity who completed a 12-month treatment programme. Previous weight loss attempts affect both dropout and ability to lose weight.

## KEYWORDS

binge-eating disorder, nocturnal eating, obesity, QEWP-R, weight loss

## 1 | INTRODUCTION

Non-surgical weight loss treatment in subjects with severe obesity (body mass index [BMI]  $\geq 35.0$  kg/m<sup>2</sup>)<sup>1</sup> include energy intake restriction, increased physical activity, behavioural change, and structured follow-up.<sup>2,3</sup> To achieve positive health effects, clinical guidelines advocate a weight loss of 5% to 15% over 6 to 12 months in adults.<sup>4</sup> A weight loss of  $\geq 20\%$  is possible in subjects

with severe obesity when offered within the framework of a structured treatment programme.<sup>4</sup> Weight loss treatment in severe obesity with very low energy diets (VLED) is an effective and established method in clinical use<sup>5,6</sup> and is associated with optimal weight loss with adequate adherence<sup>7-9</sup> and enhanced long-term weight loss maintenance.<sup>10</sup>

Different behavioural and psychological factors have been identified that may affect weight loss treatment.<sup>11</sup> Binge-eating disorder

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(BED), night-eating syndrome (NES) and nocturnal eating (NE) have been proposed as barriers to weight loss in patients receiving weight loss treatment.<sup>11-13</sup> The identification of BED is a subjective assessment by the individual, with the consumption of large amounts of foods and feelings of loss of control in combination with marked distress. The main difference between BED and bulimia nervosa is that BED does not include compensatory behaviours such as purging, exercise, fasting or use of diuretics or anti-obesity drugs.<sup>14</sup>

NE is one of the diagnostic criteria for NES and is defined as wake up from sleep during the night at least twice a week to eat.<sup>15</sup> Broader criteria, with a frequency of at least one time per month, have also been used to explore NE.<sup>16</sup> Individuals with NE report higher prevalence of other conditions such as overweight or obesity, restless leg syndrome, and obstructive sleep apnea compared to those who do not wake up during the night to eat.<sup>17</sup> In addition, subjects with NE may have difficulties compensating for nocturnal energy intake during the following day. Several studies, including that by Stunkard et al who in 1955 were among the first to describe NES,<sup>18</sup> have shown increased prevalence of NES and NE in subjects with obesity.<sup>12,18-21</sup>

Some psychological factors have been found to predict weight loss, while others seem to be related to unfavourable treatment outcomes.<sup>22,23</sup> For example, several previous weight loss attempts seem to predict unsuccessful weight loss outcomes.<sup>24-26</sup> Other factors such as body image or body shape concerns<sup>27</sup> and weight related self-esteem<sup>26,28</sup> have shown inconsistent association with weight loss maintenance and further studies are needed to be able to draw more reliable conclusions.<sup>22,23</sup>

The main aim of this study was to identify whether BED and NE are barriers for weight loss in subjects with severe obesity during a 12-month weight loss programme at a specialist obesity clinic. A secondary aim was to investigate if other behavioural and psychological factors such as body image, weight cycling and self-esteem have impact on outcome in weight loss treatment in this clinical setting.

## 2 | METHODS

### 2.1 | Subjects

A total of 1443 individuals (481 men and 962 women) with BMI  $\geq 35.0$  kg/m<sup>2</sup> were referred to the Regional Obesity Center at Sahlgrenska University Hospital, Gothenburg, Sweden for non-surgical weight loss treatment between 2012 and 2016 (Figure 1). Of these, 1132 individuals started treatment and were included in this clinical evaluation. This evaluation was approved by the regional ethical review board at the University of Gothenburg, Sweden and confirmed with the principles of the Declaration of Helsinki. Individual informed consent was not required.

### 2.2 | Weight loss treatment

Weight loss treatment was provided within the framework of a 12-month programme with monthly visits, which included support and medical follow-up from a specialist obesity team of trained dieticians,

#### What is already known about this subject

- Binge eating disorder and nocturnal eating is more prevalent in individuals with obesity compared with individuals with normal weight.
- There are several additional behaviour factors that have been identified as barriers for weight loss, although there are few studies solely based on subjects with severe obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) in a non-surgical clinical setting.

#### What this study adds

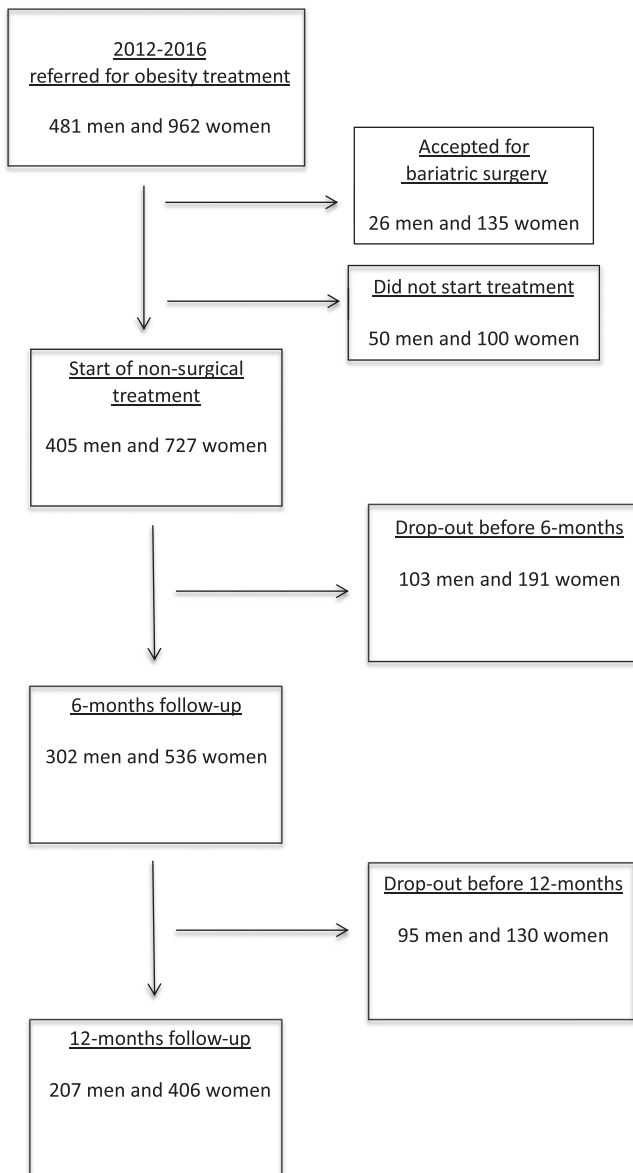
- Nocturnal eating was associated with less weight loss while several previous weight loss attempts predicted higher weight loss in those completing treatment.
- Binge eating disorder had no negative effect on 12-month weight loss in those remaining in treatment, but a higher proportion of patients with binge eating disorder did not complete the treatment programme.

nurses and physicians. The prioritized treatment for the subjects referred to the obesity centre include an initial period of formula-based VLED. Based on the pre-treatment BMI of each patient, the duration of the strict VLED-period was decided to 12 weeks for BMI 35.0 to 39.9 kg/m<sup>2</sup>, 16 weeks for BMI 40.0 to 49.9 kg/m<sup>2</sup> or 20 weeks for BMI  $\geq 50.0$  kg/m<sup>2</sup>. In addition, non-energy containing beverages were allowed *ad libitum*. VLED provides <800 kcal per day and daily recommended intake of vitamins, minerals and other essential nutrients.<sup>7</sup> The diet consisted of powder dissolved in cold or hot water and consumed as shakes or soups at four or five meals per day.

After the VLED-period, solid foods were gradually reintroduced over a period of 12 weeks. Each participant was given a written energy-restricted meal plan based on individual energy requirements using equations by Mifflin et al<sup>29</sup> for weight stability that was reduced by an additional 30% for further weight loss. The energy restriction was modified when needed for further weight loss or for weight stability. All patients on VLED treatment, paid for all the VLED-products during the treatment.

### 2.3 | Contraindications to VLED

There are some medical and psychiatric conditions that may be contraindications to the use of strict VLED, for example, type 1-diabetes, severe BED, major psychiatric disorders, severe system or organ disease (eg, severe kidney disease), pregnancy and lactation.<sup>7,30</sup> There were individual assessments by the dieticians and the physicians of all patients including clinical evaluation of the safety of the VLED treatment,<sup>7,30</sup> and all patients were carefully monitored at the monthly visits throughout the 12-month treatment period. If needed, patients could also contact the treatment team between the visits.



**FIGURE 1** Flowchart of numbers of men and women at baseline, starting non-surgical weight loss treatment, and remaining on treatment at 6 and 12 months

## 2.4 | Dietary treatment without VLED

Treatment modality was not decided by baseline weight. Individuals with contraindications to VLED<sup>7,30</sup> received energy-restricted dietary treatment including a meal plan based on individual energy requirements for weight stability with a further 30% energy restriction for weight loss, based on regular foods. The support and intensity of the follow-up were identical as for those receiving VLED.

## 2.5 | Anthropometry

Height was measured to the nearest 0.5 cm using a wall-mounted stadiometer at baseline. Body weight was measured to the nearest

0.1 kg on calibrated scales with the subjects dressed in indoor clothes without shoes at baseline and thereafter once a month.

## 2.6 | Questionnaire of eating and weight patterns-revised

The questionnaire of eating and weight patterns-revised (QEWP-R)<sup>14</sup> is a widely used self-administered screening instrument for BED and bulimia nervosa with or without compensatory behaviours.<sup>31</sup> The criteria for BED are described in (Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM5)).<sup>32</sup> The QEWP-R was completed by the participants before weight loss treatment started. In addition, the dieticians asked the participants complementary questions, for example about excessive food intake related to hunger or irregular meal pattern or restraint eating to reject or confirm the BED diagnosis. Beside screening for eating disorders, QEWP-R also assesses demographic characteristics, height and weight parameters, history of weight loss and weight- and eating behaviours such as NE.<sup>31</sup>

Most of the answers in the QEWP-R are divided into 4- or 5-point scales from “not at all” to “to an extreme degree”.<sup>31</sup> The answers used for the statistical analyses in the present study were converted into dichotomous variables where “greatly” and “extremely” were separated from “none” to “a little” when there are four answers. In cases of five answers, the variable “moderately” was grouped together with “none” and “a little”, as previously developed by Spitzer et al.<sup>31</sup> A Swedish version of QEWP-R was used. The translated version has been validated compared to the American original.<sup>31</sup> In the present study, screening for BED in QEWP-R was based on DSM5 criteria.<sup>32</sup> In QEWP-R, NE is defined as waking up at night to eat and/or drink, and thereafter go back to sleep.<sup>14,15</sup> Response alternatives in the QEWP-R for the NE-question are “once a year”, “several times per year”, “at least once a month”, “several times per month” and “several times per week”. The prevalence of NE was defined as doing so at least once monthly according to previously used definition.<sup>16</sup>

## 2.7 | Statistical analysis

Descriptive values are presented as mean and SD. Student's *t* tests were used to compare continuous variables between groups and  $\chi^2$  or Fischer's exact test was used to compare categorical variables between groups. Differences in weight loss between patients with the studied characteristics at 6 and 12 months were analysed with a general linear model adjusted for sex, age, baseline weight and treatment (VLED or dietary treatment), with estimates presented as mean and standard error of the mean (SEM) in kilograms. The effect size (Cohen's *d*) was calculated as difference between groups divided by overall pooled SD of weight loss at 6 and 12 months, respectively. Small, medium and large effect sizes was defined as  $d = 0.2, 0.5$  and  $0.8$ , respectively. Covariates were used in all models if they predicted weight loss at either 6- or 12-month in univariate analyses. Relative weight change was divided into following categories: weight gain, 0.0% to  $-4.9\%$ ,  $-5.0\%$  to  $-9.9\%$ ,  $-10.0\%$  to  $-14.9\%$  and  $\geq -15.0\%$ . Logistic regression adjusted for sex, age, baseline weight and

treatment were used to analyse associations between, (a) weight loss, more or less than 5% (excluding dropouts), and (b) drop-out at 12 months in relation to the studied characteristics. The statistical calculations were performed using the IBM SPSS statistics software program (Version 25, IBM Corp., Armonk, New York). The tests were considered significant at the level of  $P < .05$  in two-tailed analyses.

### 3 | RESULTS

Figure 1 displays the numbers of patients initially referred for treatment at the Regional Obesity Centre. Of those, 161 patients were accepted for bariatric surgery, and 150 did not start treatment at all. In total, 1132 patients started non-surgical weight loss treatment, and 838 and 613 patients remained after 6- and 12-month follow-up. Patients who started treatment were older compared to those who did not start non-surgical treatment ( $48.5 \pm 14.0$  vs  $41.7 \pm 12.9$  years,  $P < .0001$ ). There were no differences in baseline BMI between patients who started treatment and those who did not start non-surgical treatment ( $41.3 \pm 5.7$  vs  $41.7 \pm 5.2$  kg/m<sup>2</sup>,  $P = .21$ ). Of the 1132 patients who started weight loss treatment, 613 (54.2%) completed the 12-month treatment (Figure 1). The baseline characteristics of patients who started and completed treatment are given in Table 1.

#### 3.1 | Treatment groups

In the pooled group of men and women, 72% received VLED as a part of the weight loss treatment and 28% of the patients received dietary treatment without VLED.

In this evaluation, 61.5% ( $n = 120$ ) of those diagnosed with BED was given VLED treatment after careful assessment of safety. Remaining patients with BED ( $n = 75$ , 38.5%) were assessed to have more severe BED and therefore received dietary treatment without VLED from start.

In total, 319 patients received dietary treatment without VLED, 23.5% with BED and 76.5% without BED. Reasons for not receiving VLED treatment other than severe BED were unstable psychiatric disease, other serious medical conditions such as poorly controlled type 1-diabetes or severe kidney disease.

#### 3.2 | Weight change

Patients on VLED lost 3- to 4-times more weight at 6 months compared to the diet group and weight loss remained more than 2-times greater at 12 months (Table 2). There was no difference in weight loss between men and women at 6 months, mean weight loss was  $-20.8 \pm 12.6$  kg in men and  $-18.6 \pm 10.0$  kg in women ( $P = .17$  between sexes, adjusted for baseline age, weight and treatment). Corresponding mean weight loss at 12 months was  $-16.1 \pm 23.9$  kg in men and  $-21.3 \pm 10.6$  kg in women ( $P < .05$  between sexes). At 6 months, 62.8% of patients in VLED treatment and 8.7% in dietary treatment without VLED had lost  $\geq 15\%$  of baseline weight (Figure 2A). At 12 months, 53.1% of patients in VLED treatment and 17.0% in dietary treatment without VLED had lost  $\geq 15\%$  of baseline weight (Figure 2B). In total, of those 53.6% completing 12 months, 45.3% had lost  $\geq 15\%$  of baseline weight.

**TABLE 1** Baseline characteristics of all men and women ( $n = 1132$ ) and of those who completed the 12-month treatment ( $n = 613$ )

	Baseline values for all		Baseline values for 12-mo completers	
	Men	Women	Men	Women
Participants, n (%)	405 (35.8)	727 (64.2)	207 (33.8)	406 (66.2)
Age, year, mean $\pm$ SD	49.9 $\pm$ 13.1	48.9 $\pm$ 14.1	50.7 $\pm$ 13.6	50 $\pm$ 13.1
Height, cm, mean $\pm$ SD	179.2 $\pm$ 6.7	165.1 $\pm$ 7.0	178.9 $\pm$ 7.4	164.7 $\pm$ 7.0
Weight, kg, mean $\pm$ SD	133.7 $\pm$ 21.4	112.2 $\pm$ 17.6	133.3 $\pm$ 22.3	111.6 $\pm$ 17.6
BMI, kg/m <sup>2</sup> , mean $\pm$ SD	41.6 $\pm$ 6.0	41.1 $\pm$ 5.5	41.5 $\pm$ 6.0	41.1 $\pm$ 5.2
Binge-eating disorder, n (%)	57 (14.1)	138 (19.0)	21 (10.1)	63 (15.5)
Nocturnal eating <sup>a</sup> more than once per month, n (%)	55 (13.6)	92 (12.7)	22 (10.6)	44 (10.8)
Spent more than half of their adult life dieting, n (%)	58 (14.3)	346 (47.6)	20 (9.7)	159 (39.2)
Losing and regaining $\geq 10$ kg $\geq 3$ times, n (%)	166 (41.0)	383 (52.7)	77 (37.2)	187 (46.1)
Very much worried about eating more than what is good for you during last 6 mo, n (%)	212 (52.3)	498 (68.5)	105 (50.7)	55 (13.5)
Very much worried about not being able to control food intake during last 6 mo, n (%)	155 (38.3)	372 (51.2)	73 (35.3)	196 (48.3)
Weight had impact on self-esteem during last 6 mo, n (%)	197 (48.6)	472 (64.9)	88 (42.5)	269 (66.3)
Dissatisfied with body image due to obesity, n (%)	203 (50.1)	528 (72.6)	88 (42.5)	298 (73.4)

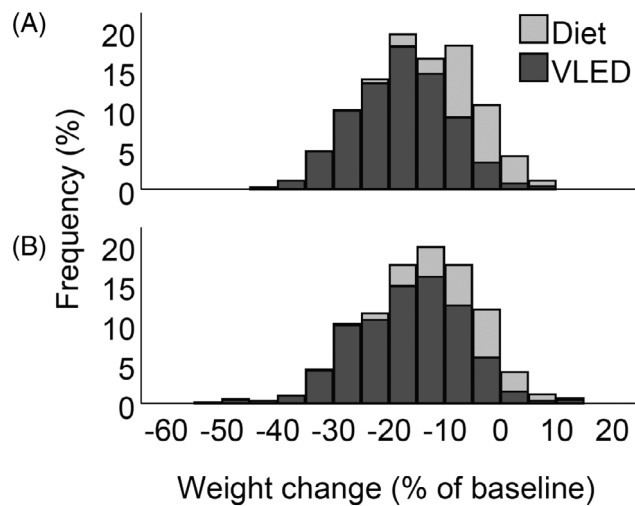
Abbreviation: BMI, body mass index.

<sup>a</sup>Wake up from sleep during night to eat.

**TABLE 2** Weight change at 6 and 12 months by sex and treatment. Mean  $\pm$  SD

	6 mo		12 mo	
	Men	Women	Men	Women
Weight change on VLED, kg	-22.8 $\pm$ 12.5 (n = 227)	-21.0 $\pm$ 11.7 (n = 407)	-21.8 $\pm$ 15.5 (n = 161)	-19.1 $\pm$ 11.6 (n = 315)
Weight change on diet, kg	-5.8 $\pm$ 7.2 (n = 75)	-7.2 $\pm$ 6.6 (n = 129)	-7.5 $\pm$ 9.7 (n = 44)	-8.6 $\pm$ 8.2 (n = 87)
P-value for difference between treatments	<.0001	<.0001	<.0001	<.0001

Abbreviation: VLED, very low energy diet.



**FIGURE 2** Frequency of weight change in 5% categories at (A) 6 months and (B) 12 months from baseline for men and women combined, on diet (dietary treatment without VLED). VLED, very low energy diet

### 3.3 | Eating and weight patterns in relation to weight change

Weight loss at 12 months did not differ significantly between patients with and without BED (Table 3). Patients with NE lost less weight compared to those without NE at 12 months. Patients who reported a history of repeated weight losses and gains lost more weight during the 12-month period compared to those with fewer losses and gains in weight. Those who reported being highly distressed by their body image lost more weight at both 6- and 12 months compared to those who reported not being distressed. There were no statistically significant differences in 6- or 12-month weight loss in patients reported having spent more than half of adulthood dieting, reported being worried by their eating habits, or in patients experiencing high weight-related impact on self-esteem. The effect-size (Cohen's *d*) showed a small to moderate effect of NE and body distress on 12 months weight loss, while the effect size was low to none for the other variables on weight (Table 3).

### 3.4 | Ability to accomplish $\geq$ 5% weight loss

At 12 months, 17.6% had lost  $<$ 5% of their initial weight or gained weight. Adjusted for sex, age, baseline weight and treatment, BED or

NE was not associated with an inability to accomplish  $\geq$ 5% weight loss; odds ratio (OR) 1.17, 95% confidence interval (CI) 0.64-2.14,  $P = .62$ , and OR 1.46, 95% CI 0.77-2.79,  $P = .25$ , respectively. Stronger weight-related impact on self-esteem and body image distress were associated with a greater likelihood of reaching  $\geq$ 5% weight loss; OR 1.66, 95% CI, 1.04-2.67,  $P = .04$ , and OR 2.08, 95% CI, 1.27-3.41,  $P = .004$ , respectively.

### 3.5 | Dropout analysis

Dropouts were younger than completers, 46.4 years vs 50.3 years in completers ( $P < .001$ ). Dropout before the end of the 12-month treatment period was associated with having experienced many previous weight loss attempts (OR 1.35, 95% CI 1.05-1.73;  $P = .02$ ) and BED (OR 1.57, 95% CI 1.14-2.17;  $P = .006$ ). Those who dropped out between 6 and 12 months had lost 6.8 kg less weight at 6 months ( $-9.1$  vs  $-15.9$  kg,  $P < .001$ ). Patients with BED who dropped out before 12 months had lost 5.8 kg less weight at 6 months ( $-8.6$  vs  $-14.4$  kg,  $P = .001$ ) and patients with NE who dropped out had lost 5.0 kg less weight at 6 months ( $-9.6$  vs  $-14.6$  kg,  $P = .001$ ), compared to completers with BED and NE respectively.

## 4 | DISCUSSION

We found that a structured weight loss programme including an initial period of VLED in unselected patients with severe obesity attending a specialist outpatient clinic produced clinically relevant and meaningful mean weight loss over 12 months. The completion rate of the 12-months programme was 54% and of the completers, 45% lost  $\geq$ 15% in weight. As hypothesized, behavioural factors related to eating and dieting were, in various degrees, related to weight loss. For example, patients with a history of several episodes of weight loss and weight regain, and those dissatisfied with their body image lost more weight than those without these characteristics, while NE was associated with less weight loss, compared to patients without NE. Patients with BED according to QEWP-R did not differ in achieved weight loss at 6- and 12 months, but had higher rate of drop-out than patients without BED.

The prevalence of BED was 5% in men and 12% in women in this group of patients with severe obesity, according to the screening questionnaire QEWP-R. In the general Swedish population, the

**TABLE 3** Weight change (kg) in relation to binge eating- and weight disorder parameters

	6 mo (n = 838) <sup>a</sup>					12 mo (n = 607) <sup>b</sup>				
	Yes	No	Diff.	P	Effect size <sup>c</sup>	Yes	No	Diff.	P	Effect size <sup>c</sup>
Binge-eating disorder, kg	-12.5 ± 0	-14.2 ± 0.4	-1.7 ± 0.9	.06	-0.14	-12.6 ± 1.3	-14.2 ± 0.6	-1.7 ± 0.4	.24	-0.13
Spent more than half of adulthood dieting, kg	-14.2 ± 0.7	-14.1 ± 0.5	0.07 ± 0.80	.93	0.01	-14.6 ± 1.0	-14.1 ± 0.7	0.5 ± 1.1	.63	0.04
Losing and regaining ≥10 kg ≥3 times, kg	-14.5 ± 0.6	-13.6 ± 0.5	0.92 ± 0.69	.18	0.08	-15.4 ± 0.8	-13.1 ± 0.7	2.3 ± 1.0	.020	0.17
Nocturnal eating <sup>d</sup> at least once per month, kg	-12.6 ± 0.97	-14.1 ± 0.44	-1.5 ± 1.0	.15	-0.13	-11.0 ± 1.5	-14.6 ± 0.7	-3.4 ± 1.6	.025	-0.27
Very much worried eating more than what is good for you during last 6 mo, kg	-13.8 ± 0.5	-14.1 ± 0.6	-0.26 ± 0.73	.73	-0.02	-13.5 ± 0.7	-14.6 ± 0.9	-1.1 ± 1.0	.28	-0.08
Very much worried not being able to control food intake during last 6 mo, kg	-14.3 ± 0.5	-13.5 ± 0.6	-0.81 ± 0.69	.24	-0.07	-13.0 ± 0.8	-14.8 ± 0.7	-1.8 ± 1.0	.06	-0.14
Weight-related impact on self-esteem during last 6 mo, kg	-14.1 ± 0.5	-13.5 ± 0.6	-0.6 ± 0.71	.42	-0.05	-14.1 ± 0.7	-13.1 ± 0.8	-1.0 ± 1.0	.36	-0.08
Dissatisfied with body image due to obesity, kg	-14.8 ± 0.5	-12.9 ± 0.6	-1.9 ± 0.7	.012	-0.16	-15.3 ± 0.8	-12.4 ± 0.9	-2.9 ± 1.1	.008	-0.22

Note: Data for men and women combined. Mean ± SEM. Analyses adjusted for sex, age, baseline weight and treatment.

Abbreviations: SEM, standard error of the mean; QEWP-R, questionnaire of eating and weight pattern-revised.

<sup>a</sup>Men (n = 302); women (n = 536).

<sup>b</sup>Men (n = 205); women (n = 402).

<sup>c</sup>Cohen's *d* (difference/pooled SD<sub>weight loss</sub>).

<sup>d</sup>Wake up from sleep during night to eat.

prevalence of BED is about 1% to 2%.<sup>33</sup> In comparison, several international studies have shown prevalence of BED between 8% and 30%, in individuals with overweight or obesity.<sup>14,31</sup> In the present group of patients seeking weight loss treatment, BED is thus about five times more prevalent compared to the general Swedish population. Although we did not find that BED had an impact on the ability to lose weight among those completing the weight loss programme, BED-diagnosis was associated with higher risk of not pursuing the programme.

BED is a complex disorder where control over eating and perception of body weight plays a major role for the individual and the knowledge of VLED treatment and its effect on the BED is not consistent between studies.<sup>34,35</sup>

For weight loss treatment including a period with strict VLED, severe BED is a contraindication. In addition to the answers in the QEWP-R and scoring of BED, each patient was thoroughly interviewed in order to determine the severity of the BED. The diagnostic questions in the QEWP-R together with the interview resulted in a group of patients, who presented alternative causes for the eating behaviour that is typically for BED. For example, a patient could skip meals during the day and then overeat in the evening due to increased hunger, and interpreted this behaviour as loss of control. Moreover, feelings of anxiety and shame when eating calorie dense food could be perceived as a failure when the purpose was to eat healthy in order to lose weight. Such actions were not regarded as severe by the patient or by the dietician who interviewed the patients, and

therefore did not prevent VLED-treatment. Therefore, we identify an intermediate group of patients with non-severe BED that could safely use VLED as a part of the weight loss treatment. Some studies have diagnosed eating disorder,<sup>36</sup> or potential eating disorder<sup>37</sup> in the exclusion criteria that prohibit some patient a weight loss treatment that may be safe. Therefore, it is of great importance with careful follow-up during weight loss treatment with VLED, as well as other interventions that may affect binge eating episodes or worsening well-being in individuals with BED.

NE was identified as an estimated frequency of at least once per month<sup>16</sup> and was reported by approximately the same percentage in both men and women. The choice of cut-off for NE vs non-NE were also made to reflect a frequency that may imply a certain regularity in generating a positive energy intake by the eating behaviour. We found that patients with NE lost less weight at 12-month follow-up, suggesting that presence of NE makes it harder lose weight. There may be several potential mechanisms why NE was associated with less weight loss. It may be harder to control energy intake during the night and to compensate by reduce energy intake during the day. Also, the type of foods ingested during the night are often energy dense, for example, sandwiches, chocolate, sweets, cheese, and ice cream<sup>16,38</sup> which makes compensation even less likely.

Several studies in both specialist- and primary care have included VLED as part of a structured weight loss programme for subjects with severe obesity<sup>5,39,40</sup> and have shown to produce clinically significant weight loss.<sup>5,37,39</sup> In the present evaluation, weight loss with VLED was 2- to 4-times higher over 6- to 12 months, compared to dietary energy restriction without VLED. The results are comparable to other interventions including VLED in different groups and settings.<sup>37,39,41</sup> Importantly, long-term weight loss maintenance, >12 months, has also been found to be improved after a weight loss regime including VLED compared to dietary energy restriction<sup>8,10</sup> also including groups with type 2-diabetes.<sup>42,43</sup> Although most of the studies includes cohorts of subjects with both overweight and obesity, Pekkarinen et al,<sup>9</sup> found a maintained  $\geq 5\%$  weight loss in 33% of the subjects 2 years after an initial period of strict VLED in a cohort with similar BMI as in our study. In addition, Anderson et al<sup>10</sup> confirmed in a meta-analysis the positive effect of larger weight loss early in the weight loss-phase on maintaining the weight loss in long term follow-up.

The majority (54%) of patients completed the present study and lost 5% to 15% in weight, which is line with target results as formulated in international guidelines for management of adults with obesity<sup>4</sup> In addition, 45% of the patients lost  $\geq 15\%$  in weight which is a level that this group with severe obesity would benefit from in terms of cardiovascular risk reduction,<sup>44</sup> although cardiovascular risk factors were not analysed in this evaluation.

A majority of the participants in our study reported having spent at least half of their adult life dieting and had also experienced losing and regaining weight on several occasions. Repeated efforts to lose weight and eventually regain weight have been associated with negative psychological effects,<sup>45,46</sup> although others have not been able to confirm this association.<sup>47,48</sup> However, in the present study, participants who reported several large variations in weight lost

approximately 2.3 kg more weight than those that did not have that experience. This indicates that repeated losses and regain of weight does not have to be a barrier for weight loss treatment. One reason might be that those with several previous weight losses know how to lose weight and can adapt more efficiently to a strict programme as successful dieters. On the other hand, we found that, a larger proportion of frequent dieters dropped out before the end of the treatment. It might be that there are other contributing barriers, for example, additional psychiatric disorder that affects the ability to maintain a weight loss. The association between repeated weight-losses and -gains highlight some of the multifactorial complexity in the treatment of obesity.

Patients in the present evaluation who reported more dissatisfaction with their body image lost additional 2 to 3 kg over 6 to 12 months compared to those who reported less dissatisfaction. This dissatisfaction may be an internal driver to increase adherence to a weight loss programme in order to remove the source of dissatisfaction.<sup>46</sup>

Many previous attempts to lose weight, being worried about losing control of food intake or worrying eating too much, did not seem to negatively affect weight loss in this study. In these cases, a majority of the subjects lost  $\geq 10\%$  of their initial weight. Although, some behaviours are interpreted as potentially negative in relation to weight loss, they may have less of an influence on weight loss than expected.<sup>23</sup> Thus, it is important that health professionals do not focus on behaviours that do not have negative impact on weight loss, although they may be troublesome in other ways for the individual patient.

A strength of the present evaluation was a large and representative population of patients with severe obesity referred to an obesity clinic over a 5-year time period. The study included a relatively large proportion of men (approximately 37%) and covered ages between 18 and 80 years. Another strength was the use of a structured, evidence-based weight loss programme including VLED, which is a well-documented, effective, and safe non-surgical weight loss method that could be offered to a majority of those referred to the clinic. Also, due to the careful investigation of each patient in terms of contraindications for VLED before treatment start, it was possible to identify patients who were initially diagnosed with BED with the screening instrument, but when were asked further questions regarding their eating habits, and safety was evaluated, still could use VLED. Thus, the BED-diagnosis may not be an absolute contraindication when having the possibilities for a thorough investigation and a close follow-up.

There are also limitations of the present study to be acknowledged. Primarily, this was not a randomized, controlled study but a retrospective clinical evaluation, which can explain the dropout of 46% at 12-month. Diet attrition and dropout from weight loss treatment programmes have shown to be between 30% and 80% in studies performed in clinical settings<sup>49,50</sup> In the clinical setting of the present study, drop-out at 6 and 12 months follow-up were 26% and 46%. These percentages are in correspondence with previous studies.<sup>49,50</sup> Since almost half of the subjects did not complete the

treatment, a drop-out analysis was performed. The patients who dropped out were younger than those completing treatment. Also, there were a higher proportion of patients with BED and patients with experience of many previous weight loss attempts. Due to the high dropout there was a relatively small number of subjects with BED left at the 12-month follow-up. However, weight loss at 6 months did not differ between BED and non-BED among those who dropped out from treatment after 6 months but before 12 months, which indicate that weight loss was not affected by BED, at least not during the first 6 months of treatment. Although the results are based on completers' analysis, attributes of those not completing are valuable in order to develop a weight loss treatment in which adherence can be optimized.

Several of the outcomes from the QEWP-R were analysed as dichotomous variables. This could be a possible limitation due to loss of sensitivity in the potential association with weight loss. The division of each variable was done in the same way; "non", "a little", "moderately" were divided from "greatly" and "extremely". One reason for dichotomizing the five categories in the scale was the non-linear and potentially unequal ranges of the categories. This could have violated the assumptions of the linear regression analysis.

The inclusion criterion of being able to read and understanding the Swedish language and having learning disabilities prohibits the results to be generalized to groups without these abilities. Also, we do not know whether the results are reproducible in subjects with BMI 30 kg/m<sup>2</sup> up to 35 kg/m<sup>2</sup> or in groups with overweight. Finally, we have evaluated a range of factors including BED and NE that were potentially related to weight loss, but there may be other factors such as other psychiatric disorders or perceived stress that might affect weight loss, which were not included in this evaluation.

In conclusion, BED does not seem to impede weight loss within a structured weight loss programme for patients with severe obesity. The presence of NE led to less weight loss during 12-month treatment. We found behavioural and psychological factors that can affect weight loss and also may have impact on the ability for persons with severe obesity to proceed in a structured weight loss programme. The identification of such factors and address them within the treatment programme should be essential in order to optimize weight management and prevent dropout from treatment for patients with severe obesity.

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#### CONFLICT OF INTEREST

Dr Wallengren reports personal fees from Impolin AB, Sweden, outside the submitted work. Dr Eliasson reports personal fees from AMGEN, personal fees from AstraZeneca, personal fees from Boehringer Ingelheim, personal fees from Eli Lilly, personal fees from Merck Sharp & Dohme, personal fees from Mundipharma, personal fees from Navamedic, personal fees from NovoNordisk, personal fees from RLS Global, grants and personal fees from Sanofi, outside the

submitted work. Dr Larsson reports personal fees from Navamedic AB, personal fees from Eli Lilly Sweden, personal fees from Novo Nordisk, personal fees from Merck Sharp and Dohme, personal fees from Fazer AB, personal fees from NJIE Foods, outside the submitted work. Drs Björkman and Laurenus have nothing to disclose.

#### AUTHOR CONTRIBUTIONS

Sofia Björkman, Björn Eliasson and Ingrid Larsson designed the study. Sofia Björkman, Ola Wallengren and Ingrid Larsson performed the statistical analyses. Sofia Björkman and Ingrid Larsson wrote the manuscript. Sofia Björkman, Ola Wallengren, Anna Laurenus, Björn Eliasson and Ingrid Larsson contributed to data interpretation and provided critical revision of the manuscript. All authors gave final approval of the submitted and published versions.

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#### REFERENCES

- Okosun IS, Chandra KM, Boev A, et al. Abdominal adiposity in U.S. adults: prevalence and trends, 1960-2000. *Prev Med.* 2004;39(1):197-206.
- Bray GA, Heisel WE, Afshin A, et al. The science of obesity management: an endocrine society scientific statement. *Endocr Rev.* 2018;39(2):79-132.
- Heymsfield SB, Wadden TA. Mechanisms, pathophysiology, and management of obesity. *N Engl J Med.* 2017;376(15):1492.
- Yumuk V, Tsigos C, Fried M, et al. European guidelines for obesity management in adults. *Obes Facts.* 2015;8(6):402-424.
- Parretti HM, Jebb SA, Johns DJ, Lewis AL, Christian-Brown AM, Aveyard P. Clinical effectiveness of very-low-energy diets in the management of weight loss: a systematic review and meta-analysis of randomized controlled trials. *Obes Rev.* 2016;17(3):225-234.
- Leslie WS, Taylor R, Harris L, Lean ME. Weight losses with low-energy formula diets in obese patients with and without type 2 diabetes: systematic review and meta-analysis. *Int J Obes.* 2017;41(1):96-101.
- Mustajoki P, Pekkarinen T. Very low energy diets in the treatment of obesity. *Obes Rev.* 2001;2(1):61-72.
- Pekkarinen T, Kaukua J, Mustajoki P. Long-term weight maintenance after a 17-week weight loss intervention with or without a one-year maintenance program: a randomized controlled trial. *J Obes.* 2015;2015:460.
- Tsai AG, Wadden TA. The evolution of very-low-calorie diets: an update and meta-analysis. *Obesity.* 2006;14(8):1283-1293.
- Anderson JW, Konz EC, Frederich RC, Wood CL. Long-term weight-loss maintenance: a meta-analysis of US studies. *Am J Clin Nutr.* 2001;74(5):579-584.
- Elfhag K, Rossner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obes Rev.* 2005;6(1):67-85.
- Colles SL, Dixon JB, O'Brien PE. Night eating syndrome and nocturnal snacking: association with obesity, binge eating and psychological distress. *Int J Obes.* 2007;31(11):1722-1730.
- de Man LJ, Ghaderi A, Norring C. Eating disorders and disordered eating among patients seeking non-surgical weight-loss treatment in Sweden. *Eat Behav.* 2006;7(1):15-26.
- Yanovski SZ. Binge eating disorder: current knowledge and future directions. *Obes Res.* 1993;1(4):306-324.



15. Allison KC, Lundgren JD, O'Reardon JP, et al. Proposed diagnostic criteria for night eating syndrome. *Int J Eat Disord*. 2010;43(3):241-247.
16. de Zwaan M, Roerig DB, Crosby RD, Karaz S, Mitchell JE. Nighttime eating: a descriptive study. *Int J Eat Disord*. 2006;39(3):224-232.
17. Schenck CH, Mahowald MW. Review of nocturnal sleep-related eating disorders. *Int J Eat Disord*. 1994;15(4):343-356.
18. Stunkard AJ, Grace WJ, Wolff HG. The night-eating syndrome; a pattern of food intake among certain obese patients. *Am J Med*. 1955;19(1):78-86.
19. Aronoff NJ, Geliebter A, Zammit G. Gender and body mass index as related to the night-eating syndrome in obese outpatients. *J Am Diet Assoc*. 2001;101(1):102-104.
20. Striegel-Moore RH, Rosselli F, Wilson GT, Perrin N, Harvey K, DeBar L. Nocturnal eating: association with binge eating, obesity, and psychological distress. *Int J Eat Disord*. 2010;43(6):520-526.
21. Vander Wal JS. Night eating syndrome: a critical review of the literature. *Clin Psychol Rev*. 2012;32(1):49-59.
22. Teixeira PJ, Going SB, Sardinha LB, Lohman TG. A review of psychosocial pre-treatment predictors of weight control. *Obes Rev*. 2005;6(1):43-65.
23. Carraca EV, Santos I, Mata J, Teixeira PJ. Psychosocial pretreatment predictors of weight control: a systematic review update. *Obes Facts*. 2018;11(1):67-82.
24. Forster JL, Jeffery RW. Gender differences related to weight history, eating patterns, efficacy expectations, self-esteem, and weight loss among participants in a weight reduction program. *Addict Behav*. 1986;11(2):141-147.
25. Teixeira PJ, Going SB, Houtkooper LB, et al. Weight loss readiness in middle-aged women: psychosocial predictors of success for behavioral weight reduction. *J Behav Med*. 2002;25(6):499-523.
26. Teixeira PJ, Going SB, Houtkooper LB, et al. Pretreatment predictors of attrition and successful weight management in women. *Int J Obes Relat Metab Disord*. 2004;28(9):1124-1133.
27. Sarwer DB, Wadden TA, Foster GD. Assessment of body image dissatisfaction in obese women: specificity, severity, and clinical significance. *J Consult Clin Psychol*. 1998;66(4):651-654.
28. Nir Z, Neumann L. Relationship among self-esteem, internal-external locus of control, and weight change after participation in a weight reduction program. *J Clin Psychol*. 1995;51(4):482-490.
29. Mifflin MD, St Jeor ST, Hill LA, Scott BJ, Daugherty SA, Koh YO. A new predictive equation for resting energy expenditure in healthy individuals. *Am J Clin Nutr*. 1990;51(2):241-247.
30. Brown A, Frost G, Taheri S. Is there a place for low-energy formula diets in weight management. *Br J Obes*. 2015;1:106-113.
31. Spitzer RL, Yanovski S, Wadden T, et al. Binge eating disorder: its further validation in a multisite study. *Int J Eat Disord*. 1993;13(2):137-153.
32. Association AP. *Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5)*. 5th ed. Arlington, VA: American Psychiatric Association; 2013.
33. Elfhag K, Rossner S. Obesity patients with eating disorders risk ending up between medicine and psychiatry. *Lakartidningen*. 2007;104(7):494-497.
34. da Luz FQ, Hay P, Gibson AA, et al. Does severe dietary energy restriction increase binge eating in overweight or obese individuals? A systematic review. *Obes Rev*. 2015;16(8):652-665.
35. LaPorte DJ. Treatment response in obese binge eaters: preliminary results using a very low calorie diet (VLCD) and behavior therapy. *Addict Behav*. 1992;17(3):247-257.
36. Lean ME, Leslie WS, Barnes AC, et al. Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. *Lancet*. 2018;391(10120):541-551.
37. Ard JD, Lewis KH, Rothberg A, et al. Effectiveness of a total meal replacement program (OPTIFAST program) on weight loss: results from the OPTIWIN study. *Obesity*. 2019;27(1):22-29.
38. Cerú-Björk C, Andersson I, Rössner S. Night eating and nocturnal eating—two different or similar syndromes among obese patients? *Int J Obes*. 2001;25(3):365-372.
39. Lean M, Brosnahan N, McLoone P, et al. Feasibility and indicative results from a 12-month low-energy liquid diet treatment and maintenance programme for severe obesity. *Br J Gen Pract*. 2013;63(607):115-124.
40. Astbury NM, Piernas C, Hartmann-Boyce J, Lapworth S, Aveyard P, Jebb SA. A systematic review and meta-analysis of the effectiveness of meal replacements for weight loss. *Obes Rev*. 2019;20(4):569-587.
41. McCombie L, Brosnahan N, Ross H, Bell-Higgs A, Govan L, Lean MEJ. Filling the intervention gap: service evaluation of an intensive non-surgical weight management programme for severe and complex obesity. *J Hum Nutr Diet*. 2019;32(3):329-337.
42. Unick JL, Neiberg RH, Hogan PE, et al. Weight change in the first 2 months of a lifestyle intervention predicts weight changes 8 years later. *Obesity (Silver Spring)*. 2015;23(7):1353-1356.
43. Lean MEJ, Leslie WS, Barnes AC, et al. Durability of a primary care-led weight-management intervention for remission of type 2 diabetes: 2-year results of the DiRECT open-label, cluster-randomised trial. *Lancet Diabetes Endocrinol*. 2019;7(5):344-355.
44. Ryan DH, Yockey SR. Weight loss and improvement in comorbidity: differences at 5%, 10%, 15%, and over. *Curr Obes Rep*. 2017;6(2):187-194.
45. Brownell KD, Rodin J. Medical, metabolic, and psychological effects of weight cycling. *Arch Intern Med*. 1994;154(12):1325-1330.
46. Friedman MA, Schwartz MB, Brownell KD. Differential relation of psychological functioning with the history and experience of weight cycling. *J Consult Clin Psychol*. 1998;66(4):646-650.
47. Foster GD, Wadden TA, Kendall PC, Stunkard AJ, Vogt RA. Psychological effects of weight loss and regain: a prospective evaluation. *J Consult Clin Psychol*. 1996;64(4):752-757.
48. El Ghoch M, Calugi S, Dalle GR. Weight cycling in adults with severe obesity: a longitudinal study. *Nutr Diet*. 2018;75(3):256-262.
49. Moroshko I, Brennan L, O'Brien P. Predictors of dropout in weight loss interventions: a systematic review of the literature. *Obes Rev*. 2011;12(11):912-934.
50. Dalle Grave R, Calugi S, Molinari E, et al. Weight loss expectations in obese patients and treatment attrition: an observational multicenter study. *Obes Res*. 2005;13(11):1961-1969.

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