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BRIEF REPORT

Relationship between multiple weight cycles and early weight loss in patients with obesity: a longitudinal study

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Abstract

Purpose To assess the relationship between multiple weight cycling (WC) and early weight loss (e-WL).

Methods Using a longitudinal prospective design conducted between May 2017 and November 2019, early weight loss was assessed at month 2 of a weight management programme in 100 adult participants with overweight or obesity, at the Outpatient Clinic of the Department of Nutrition and Dietetics at Beirut Arab University (Lebanon). Weight cycling was defined as intentional weight loss of ≥ 3 kg followed by involuntary weight regain of ≥ 3 kg and participants were then categorized as multiple WC if they had experienced ≥ 2 cycles.

Results Of the 100 participants with a median age of 34.90 (22.94–50.67) years and a median BMI of 35.25 (32.75–39.48) kg/m^2, 75 met the criteria for WC and displayed a lower e-WL percentage than those without WC (4.69 ± 2.78% vs. 6.58 ± 2.80%; p = 0.006). Linear regression analysis showed that e-WL was lower by ≈ 2% ($\beta = -1.935$; 95% CL −3.221, −0.648; p = 0.004) in the WC group compared to the non-WC group after adjusting for age, gender and baseline BMI.

Conclusion In a 'real-world' clinical setting, multiple WC decreases e-WL rates. New strategies could be adopted for these patients to improve this early clinical outcome, since e-WL predicts longer-term success.

Level of evidence III, prospective longitudinal study.

Keywords BMI · Obesity · Multiple weight cycling · Early weight loss · Clinical outcomes

Introduction

Obesity is an increasing health problem worldwide which is associated with serious medical and psychosocial comorbidities and high rates of mortality [1]. This unavoidably prompted international guidelines to recommend a wide range of weight-loss interventions, in the first line, lifestyle modification programmes, mainly considered the key element of weight management for patients with obesity, as well as anti-obesity drugs and bariatric surgery [1]. However, despite this, weight regain is common in patients with obesity who have intentionally lost weight regardless of the type of intervention and has not yet been fully understood [2]. Therefore, the identification of baseline or early factors related to favourable outcome [3], namely long-term weight-loss maintenance, should be considered a priority for researchers due to the clinical relevance of the issue [3]. In particular, early weight loss (e-WL) is a strong predictor of longer-term and clinically meaningful weight-loss maintenance [4]. In fact, the e-WL during the first 2 months of intensive lifestyle intervention (i.e., Look Ahead study) has been found to predict long-term success, with a significant relationship between initial weight loss (first 2 months of treatment) and long-term weight loss (8 years after initial treatment) [4].

The repeated failure in the long-term maintenance of weight loss leads to body weight fluctuation over time and this phenomenon has been termed 'weight cycling' (WC) [5]. In the

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last few decades, there has been a particular interest in the effects of repeated WC in humans [5]. Despite the fact that several studies investigated the association between WC and health outcomes (i.e., body composition, energy expenditure and cardiovascular and metabolic status) [5], there is still a lack of studies that have assessed the effect of this phenomenon on treatment outcomes (i.e., attrition, early and late weight-loss rates, and weight-loss maintenance), which still remains to be explored.

In light of these considerations, the current study aimed to investigate the relationship between multiple WC and e-WL rates in a 'real-world' clinical setting of treatment-seeking patients with overweight or obesity. Our hypothesis sought to find a relationship between the presence of multiple WC and lower e-WL rates.

Methods

Participants and study design

Participants were selected from a cohort of 195 participants with overweight or obesity of both genders seeking weight-loss treatment were recruited consecutively, referred by general practitioners to the Nutritional and Weight Management Outpatient Clinic in the Department of Nutrition and Dietetics at Beirut Arab University (BAU) in Lebanon during the period May 2017 to November 2019. Patients were considered eligible if they were aged ≥ 18 years, with a BMI of ≥ 25.0 kg/m^2 and had at least one of a number of weight-related comorbidities (i.e., type 2 diabetes, cardiovascular disease, sleep apnoea, severe joint disease, etc.) [6], as well as having been identified as suitable for weight-loss treatment which they had effectively started. A total of 100 of the 154 patients who started treatment and assessed for eligibility were included, because they met the following conditions: they (1) were effectively enrolled on the programme and (2) did not interrupted treatment during the weight-loss phase (before 8 weeks). The programme featured a low-calorie diet and the protocol for the treatment essentially involved a personalized cognitive behavioural treatment (CBT-OB) programme designed for patients with obesity as described elsewhere, where patients are instructed to follow a low-energy diet (LED) eating plan based on the Mediterranean diet [7]. The study was approved by the Institutional Review Board of Beirut Arab University and all participants provided informed written consent.

Measures

Baseline measures

A questionnaire was administered to participants to retrieve information regarding their social demographic (age, marital status, employment, level of education, etc.). Moreover, the number of past intentional weight-loss attempts were carefully evaluated by a trained physician. Weight cycling was defined elsewhere as intentional weight loss of ≥ 3 kg followed by involuntary weight regain of ≥ 3 kg [8]. The frequency of WC was expressed as number of weight cycles. Participants were considered multiple weight cyclers if they experienced ≥ 2 cycles according to the definition mentioned above [8].

Participants were weighed barefoot and wearing light indoor clothing to the nearest 0.1 kg and height was measured to the nearest 0.5 cm using an electronic weighing scale (SECA 2730-ASTRA, Hamburg, Germany) and a stadiometer. Then, BMI was calculated according to the standard formula of body weight measured in kilograms, divided by the square of the height in metres.

Body composition was measured using a segmental body composition analyser (MC-780MA, Tanita Corp., Tokyo, Japan) [9]. After the gender, age and height information had been entered into the device, participants were asked to stand in a stable position in bare feet. The device provided separate body mass readings for different segments of the body, using an algorithm incorporating impedance, age and height to estimate the total and regional fat mass (FM) and fat free mass (FFM) [9].

Eight week measures

Early weight loss was assessed at 8 weeks by analysing the participants' medical records, which contained the date of the visit when patients were registered.

Data analysis

The normality of the data was checked using Shapiro–Wilk or Kolmogorov–Smirnov tests as well as a quantile–quantile (Q–Q) plot. The data for the outcomes of interest, namely e-WL (kg) and e-WL%, were normally distributed. Accordingly, parametric analysis was conducted for these variables. Non-parametric analysis was used for other variables. The data are presented as mean ± SD or medians and interquartile ranges and proportions for continuous and categorical variables, respectively. A comparison of means was conducted using a Student's *t* test and Mann–Whitney *U* test as appropriate. Simple linear regression was used to assess the association between WC and e-WL% at month 2 of treatment, with WC as an independent variable and e-WL% as a dependant variable. Multiple regression analysis was also conducted while adjusting for age, gender and baseline BMI. Diagnostic tests of the regression assumption for linearity, equal variance and the normality of residuals, and the variance inflation factor (VIF) for testing collinearity between independent variables were employed. All analyses were performed using SPSS version 26.0 (IBM Corp.; IBM, Armonk, NY, USA). Tests were considered statistically significant at $p < 0.05$.

Results

The socio demographic, baseline anthropometric and body composition characteristics of the study participants are shown in Tables 1 and 2. Among the entire sample, 75% of participants had WC and 25% did not. At baseline, participants with WC had only a higher level of education when compared to non-WC participants (41.3% vs. 16%; $p = 0.021$) (Table 1) and did not differ in any other variable (Tables 1 and 2).

At 8 weeks of treatment, the WC and non-WC groups did not have a significant difference in body weight (92.49 ± 17.65 vs. 87.39 ± 14.79; $p = 0.162$), but participants with WC displayed a significantly lower e-WL (4.48 ± 2.62 kg vs. 6.30 ± 3.22 kg; $p = 0.015$) and e-WL% (4.69 ± 2.78% vs. 6.58 ± 2.80%; $p = 0.006$) compared to non-WC participants (Table 3).

In the same direction, multiple linear regression analysis showed that the e-WL% over the first 8 weeks of treatment was lower by nearly 2% ($\beta = -1.935$; 95% CL −3.221, −0.648; $p = 0.004$) in the WC when compared to the non-WC group after adjusting for age, gender and baseline BMI.

Table 1 Sociodemographic characteristics of the study population ($N = 100$)

	Total (N = 100)	Non-WC (N = 25)	WC (N = 75)	Significance
Age (years)	34.90 (22.94–50.67)	31.85 (20.16–53.56)	36.68 (24.77–50.36)	$p = 0.670^{¥}$
Gender				$X^2 = 0.292$; $p = 0.589$
Male	24 (24.0)	5 (20.0)	19 (25.3)	
Female	76 (76.0)	20 (80.0)	56 (74.7)	
Employment				$X^2 = 0.377$; $p = 0.539$
Not employed	67 (67.0)	18 (72.0)	49 (65.3)	
Employed	33 (33.0)	32 (44.4)	26 (34.7)	
Education				$X^2 = 0.528$; $p = 0.021$
Lower education	65 (65.0)	21 (84.0)	44 (58.7)	
Higher education	35 (35.0)	4 (16.0)	31 (41.3)	
Smoking				$X^2 = 0.069$; $p = 0.792$
Smoker	74 (74.0)	19 (76.0)	55 (73.3)	
Non smoker	26 (26.0)	6 (24.0)	20 (26.7)	

Values are expressed as *n* (%) and mean (SD) for categorical and continuous variables, respectively

¥Values are median (IQR), results are for non-parametric comparison using Mann–Whitney *U* test

Table 2 Baseline anthropometric and body composition characteristics of the study population ($N = 100$)

	Total (N = 100)	Non-WC (N = 25)	WC (N = 75)	$p^{¥}$
Weight (kg)	93.60 (83.13–104.28)	92.30 (81.25–103.65)	94.70 (86.20–104.50)	0.392
Height (m)	161.25 (155.50–165.88)	159.00 (151.00–164.25)	162.50 (156.50–167.00)	0.074
BMI (kg/m^2)	35.25 (32.75–39.48)	35.26 (32.64–40.30)	35.24 (32.91–39.22)	0.883
FM (kg)	37.75 (31.30–44.38)	35.70 (29.55–42.90)	38.10 (33.40–44.50)	0.239
FM (%)	40.95 (36.53–44.85)	38.90 (36.05–43.10)	41.40 (36.80–45.20)	0.148
FFM (kg)	53.80 (48.15–62.33)	54.00 (48.10–63.35)	53.70 (48.30–61.80)	0.808
FFM (%)	59.05 (54.91–63.47)	61.10 (56.90–63.97)	58.63 (54.68–63.16)	0.139
WC frequency	4.00 (1.25–7.00)	1.00 (0.00–1.00)	5.00 (3.00–9.00)	< 0.001
No	25 (25.0)	25 (100)	0 (0)	
Yes	75 (75.0)	0 (0)	75 (0)	

Values are expressed as *n* (%) and median (IQR), for categorical and continuous variables, respectively

BMI body mass index, *FM* fat mass, *FFM* fat free mass, *WC* weight cycling

¥Results are for non-parametric comparison using Mann–Whitney *U* test

Discussion

Our study aimed to provide preliminary data on the relationship between multiple WC and treatment outcomes, namely, the e-WL rate in adults with overweight or obesity. In turn, one major finding was revealed.

The group of participants with multiple WC experienced lower rates of e-WL% compared to their non-WC counterparts (4.69 ± 2.78% vs. 6.58 ± 2.80%; $p = 0.006$). In fact, the presence of multiple WC status decreased the rate of e-WL% by nearly 2% compared with those without WC while controlling for age, gender and baseline BMI. To date, our study is the first to report such a finding in the literature and it is, therefore, difficult to compare it with previous studies conducted among this population. We speculate that the reasons behind our finding—namely the reduced e-WL%—in patients with multiple WC could stem from: (1) the reduced muscle mass and strength [8] or/and (2) the persistence of metabolic adaptation [10] among weight cyclers, as has been reported in two recent studies and that this can be translated into a more sedentary lifestyle and resting energy expenditure, and consequently a less prominent weight loss when compared to those without WC. Consequently, future studies focusing on the mechanisms behind the relationship between WC and treatment outcomes (i.e., weight-loss rates, weight maintenance) are needed if firm conclusions are to be drawn.

Moreover, looking at the bigger picture, WC is a common phenomenon represented by repeated weight regain following intentional weight-loss attempts regardless of the nature of the treatment [1]. Several factors have been identified that seem to be involved in body weight regulation that are an obstacle to weight-loss maintenance in the long-term and unavoidably lead to WC, and these have been categorized into four main subgroups; (1) biological (e.g., homeostatic system and hypothalamic hormonal appetite regulation); (2) environmental (e.g., food availability); (3) behavioural (e.g., overfeeding and sedentary lifestyle); and (4) cognitive (e.g., problematic thoughts) as well as emotional (i.e., hedonic and emotional eating) factors [3, 11]. Therefore, to prevent WC, future studies that clarify the role of these factors in WC are needed, to identify a wide range of effective strategies (i.e., dietary, psychological, pharmacological and others) to be implemented for the same aim.

Our study has certain strengths. Principally, to the best of our knowledge, it is the first to assess the relationship between e-WL rates and WC in treatment-seeking patients with overweight or obesity. Furthermore, the longitudinal design and the ‘real-world’ clinical setting of the study should be considered strengths. However, our study did have some limitations. First, our sample included only patients seeking an outpatient weight management treatment programme, hence, our findings are not extendable to patients with obesity who seek other treatment modalities (i.e., bariatric surgery, pharmacological interventions, etc.). Second, the information relative to WC was self-reported and did not rely on objective assessment. Third, we relied on an arbitrary definition of WC, which is a common limitation of the studies on this topic due to the lack of a standardized definition of WC. Fourth, although we did measure a wide range of sociodemographic and body composition variables, we did not measure and, therefore, cannot rule out the existence of other factors (such as medications, stress and biochemical make-up) which maybe affected by or affect WC and weight status. Finally, due to the relatively small sample size, these results are preliminary and need further replication. If confirmed, our finding may have relevant clinical implications for targeting patients with WC who may experience low e-WL rates, considered a powerful independent predictor of weight in long-term weight-loss-maintenance (i.e., at 8 years of follow-up), as implementing additional strategies for this subgroup of patients may be useful in reducing treatment attrition.

Conclusions

In our study, we provide evidence that multiple WC status may lead to lower rates of e-WL. Certainly, this finding needs to be replicated using larger samples and if confirmed, provides a new direction for future studies seeking to determine the impact of this phenotype (i.e., multiple WC) on longer-term clinical outcomes, as well as emphasizing the importance of developing further strategies for these patients in weight management programmes.

Table 3 Body weight, e-WL and e-WL% at 8 weeks of the study population[§]

	Total ($N = 100$)	Non-WC ($N = 25$)	WC ($N = 75$)	p*
Weight at 8 weeks (kg)	91.22 (17.06)	87.39 (14.79)	92.49 (17.65)	0.162
e-WL at 8 weeks (kg)	4.93 (2.88)	6.30 (3.22)	4.48 (2.62)	0.015
e-WL% at 8 weeks (%)	5.16 (2.89)	6.58 (2.80)	4.69 (2.7)	0.006

e-WL early weight loss

*Values are expressed as mean (SD) and results are for student *t* test

What is already known on this subject?

Over the past decade, a number of studies have emerged, suggesting that e-WL is a strong predictor of longer-term weight-loss maintenance. However, few researches have been conducted to identify factors related to this outcome. In the present study, we examined the relationship between multiple WC and e-WL.

What does this study add?

This study indicates that in a 'real-world' clinical setting, multiple WC decreases e-WL rates. Future research should focus on the identification and adoption of new strategies for seeking-treatment patients that experienced repeated WC to improve this early clinical outcome, since e-WL predicts longer-term success.

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Compliance with ethical standards

Conflict of interest There is no conflict of interest to report.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of Beirut Arab University research ethics committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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