

RESEARCH PAPER

Prevalence and predictors of weight loss maintenance: a retrospective population-based survey of European adults with overweight and obesity

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Abstract

Background: The prevalence of weight loss attempts has increased worldwide, although the extent to which sustained weight loss is achieved is unknown. There is insufficient research into weight loss maintenance (WLM) in individuals with overweight or obesity who have recently lost clinically significant amounts of weight ($\geq 5\%$), particularly in the European general population. The present study aimed to determine the prevalence and retrospective predictors of WLM in population-based samples of European adults with overweight or obesity who had made a recently completed weight loss attempt.

Methods: Participants ($N = 2000$) in UK, Denmark and Portugal completed an online survey about loss and regain in their most recent completed weight loss attempt, features of their attempt (duration, self-weighing, lapses, strategies), as well as loss of control and binge eating. Multiple regression analysis was used to determine factors retrospectively associated with WLM in those who achieved clinically significant weight loss ($n = 1272$).

Results: Mean (SD) self-reported weight loss was 9% (8%) and mean (SD) regain was 96.3% (9%) of participants' start weight. Twenty-three percent of the total sample had maintained weight loss of $\geq 5\%$ for at least 1 month. Controlling for weight loss and time since attempt, predictors of better WLM were avoidance of a temporary lapse, infrequent/absent loss of control and binge eating, and use of a greater number of dietary strategies for WLM ($r^2 = 0.338$, $P < 0.001$).

Principal conclusions: Factors associated with recent successful WLM indicate the importance of the continued use of dietary and other strategies for WLM, particularly in the face of a lapse, as well as the need to manage dysfunctional eating behaviours.

Introduction

More than half of adults in Western Europe have a body mass index (BMI) in the range for being overweight ($25\text{--}29.9\text{ kg m}^{-2}$) or obese ($\geq 30\text{ kg m}^{-2}$)⁽¹⁾, which is associated with an increased risk of chronic disease^(2,3) and all-cause mortality⁽⁴⁾. The prevalence of overweight/obesity has increased in recent decades⁽⁵⁾, prompting public health initiatives to encourage sustained weight control amongst the general population⁽⁶⁾. The proportion of the population engaging in weight loss efforts has also increased⁽⁷⁾, particularly amongst individuals with overweight or obesity⁽⁸⁾, although it is currently unclear whether, and with what frequency, individuals keep weight off after losing it. Weight loss maintenance (WLM) has been defined as intentional, sustained weight loss of at least 5% baseline weight⁽⁹⁾ and there is an overall perception that it is both difficult and rare⁽¹⁰⁾. Estimates of WLM lifetime prevalence from US population-based studies range from 17%⁽¹¹⁾ at $\geq 10\%$ below baseline weight for individuals who had ever been overweight or obese to 59%⁽¹²⁾ for those who had ever lost $\geq 10\%$ of their body weight. There are far fewer existing European studies, although lifetime prevalence estimates for these populations vary from 18%⁽¹³⁾ at $\geq 10\%$ below baseline weight for individuals who had ever been overweight or obese to 33%⁽¹⁴⁾ of individuals with current overweight or obesity, who maintained any weight loss at all.

Current research on WLM primarily comprises evidence from WLM randomised controlled trials (RCTs) (most of which induced initial weight loss⁽¹⁵⁾), follow-up of participants in weight loss RCTs^(16,17) and findings from long-term research cohorts such as the US national weight control registry National Weight Control Registry (NWCR)^(18–21). Currently, 80% of NWCR members are female and mean WLM is 30 kg over 5.5 years⁽²²⁾. The design of these extant studies limits their generalisability, and most weight loss attempts occur outside formal settings^(7,23), and so population-based research is also needed. However, non-RCT European studies^(13,14,24,25) tend to be small, include individuals across the whole BMI spectrum^(14,26) and focus on the prevalence and predictors of weight loss rather than WLM^(14,27,28). More generalisable is evidence from large US population-based surveys of WLM^(29,30). However, a recent systematic review concluded that evidence for many potential predictors of WLM remains insufficient⁽³¹⁾. It is unclear whether features of the weight loss attempt predict better WLM, including the level of baseline body weight loss⁽¹²⁾ and the amount of time since finishing weight loss⁽³²⁾, and the predictive role of weight loss history is similarly unclear⁽³¹⁾. Lower levels of binge eating^(29,33) and disinhibition⁽³⁴⁾ are associated with more successful WLM,

although evidence is mixed⁽³¹⁾. Higher frequency of self-weighing predicted WLM in some RCTs and in the NWCR^(31,35,36), although this has not been assessed for WLM in population-based surveys individuals with overweight or obesity⁽³⁷⁾. Finally, many different individual weight control strategies have been associated with WLM success^(12,16,38–40) but there is no consensus on the optimal dietary strategies from population-based studies, although the evidence supports the effectiveness of increased physical activity^(31,38). Demographic features (e.g. gender, age) do not appear to be associated with WLM⁽³¹⁾ but research with male participants and outside the US is lacking. Furthermore, different weight loss cut-offs and follow-up durations, and inconsistent distinctions between weight loss and WLM phases⁽⁴¹⁾, limit the comparability of available evidence.

To summarise, key research gaps in our understanding of WLM include the need to recruit male and European individuals from the general population, as well as to differentiate between strategies for weight loss and WLM. Additionally, previous cohort studies have focused on WLM of ≥ 12 months⁽³¹⁾ although one-third of lost weight is regained in the first year following weight loss⁽⁴²⁾. It is therefore useful to investigate proximal factors related to WLM in the months after individuals in the general population achieve naturalistic weight loss, when accurate recall of strategies, dates and weights is most likely. Questionnaire self-report methods offer the primary viable strategy to capture such data at scale and across nations from community-based samples, although they are prone to underreporting of weight and overreporting of height⁽⁴³⁾. Such questionnaires are increasingly delivered online to examine health behaviours in demographically diverse samples^(39,44), typically recruiting nationally representative quota-based stratified samples of probability or non-probability panel members⁽⁴⁵⁾. However, the underlying population composition of individuals with overweight or obesity who have made a weight loss attempt is unknown and, as such, it is not possible to establish that a sample definitively represents this population.

The aims of the present survey were to: (i) describe the prevalence of retrospective self-reported WLM in a sample of European adults with overweight or obesity (UK, Denmark, Portugal) who had made a recent, completed weight loss attempt; (ii) compare the strategies used for WLM with those used in active weight loss; and (iii) determine the factors associated with self-reported WLM. Weight regain after reaching the lowest weight was used to operationalise WLM dimensionally, and a cut-off of $\geq 5\%$ loss from baseline was used to define clinically significant weight loss; the latter is in keeping with prior

research and a recent systematic review^(10,31,46). If 5% weight loss was achieved and maintained at a population level, this would constitute a meaningful attenuation of the typical weight gain trajectory across adulthood⁽⁴⁷⁾. It was anticipated that the results from the exploratory analyses of factors associated with WLM would lead to recommendations for weight loss interventions (to best prepare participants for the process of maintenance), as well as interventions to support WLM.

Materials and methods

Participants and procedures

Participant inclusion criteria were:

- Age ≥ 18 years
- A highest BMI in the preceding 12-months of $\geq 25 \text{ kg m}^{-2}$ (excluding pregnancy)
- At least one *completed* deliberate weight loss attempt
- A weight loss attempt in the preceding 12 months (whether completed or ongoing).

A completed weight loss attempt was necessary to establish whether weight loss was maintained after the attempt finished. A weight loss attempt in the preceding 12 months was necessary to enable accurate recall of strategies used for weight loss. Participants were informed that this recent attempt could be completed (i.e. the same attempt as used in criterion (iii)) or it could be ongoing (i.e. a new weight loss attempt). No method of deliberate weight loss was excluded. Individuals who were currently pregnant and those who had unintentionally lost weight as a result of illness or other factors were excluded from the sample. The survey is part of a larger multicentre project aiming to design and test a digital behavioural WLM intervention in the UK, Denmark and Portugal; participants were recruited from these countries for this reason. Funding arrangements meant that a total sample of 2000 was sought in the following proportions: UK, $n = 1000$; Portugal, $n = 500$; and Denmark, $n = 500$. Recruitment ceased once this target had been achieved.

A market research company, Ipsos MORI (London, UK), built and delivered the online survey. Members of their existing non-probability research panels in each country were e-mailed with information about the study ($N = 66\,995$ in total). Ipsos MORI recruited members to the panels using a mixture of online and offline methods, as recommended to ensure the inclusion of offline households in panels⁽⁴⁸⁾, and panellists' test-taking behaviour was screened to ensure data integrity⁽⁴⁹⁾. Representative sampling frames were applied, stratifying by age, gender and geographical location based on European census data for each country⁽⁵⁰⁾. Recent major research endeavours

such as the NIH Toolbox⁽⁴⁴⁾ have utilised similar high-quality non-probability panel methods⁽⁴⁵⁾.

At the point that recruitment ceased (i.e. the target of 2000 participants was reached), 9506 individuals had opened the survey link and read the study information. They answered sequential screening questions to determine eligibility. Of the 7115 people who began screening, 5115 were screened out. Of these, 3493 had a highest 12-month BMI below 25 kg m^{-2} . Of the remaining participants, 715 had never attempted weight loss, 679 had not attempted weight loss in the preceding 12 months and 218 did not have a completed weight loss attempt. The composition of the final sample (by age and gender) compared to composition of the original stratified population is shown in the Supporting information (Table S1).

The Newcastle University Faculty of Medical Sciences ethics committee (03/09/15; ref 00902) and the University of Lisbon ethics committee (05/11/15) approved the study in the UK and Portugal, respectively; the Central Denmark Region Committee on Health Research Ethics confirmed that no ethical permissions were required. All respondents provided their informed consent prior to accessing the survey.

Measures

Respondents completed an online survey between October and November, 2015. The survey was developed in English and then forward- and back-translated by bilingual, native speakers of Portuguese and Danish from the research teams; the questions were designed to ensure cultural appropriateness in each country with the input of individuals with overweight or obesity (e.g. weight loss organisation names are country-specific). Many of the questions have been used previously and successfully in a UK population-based weight management survey⁽²³⁾.

Participants reported demographic and anthropometric details, number of lifetime weight loss attempts, and features of their most recent completed weight loss attempt (pre-weight loss weight; amount of weight lost; weight following any regain; strategies; self-weighing frequency; whether they experienced a temporary lapse *during* the weight loss attempt, defined as regain of $>1 \text{ kg}$; and their behavioural response to that lapse: avoid weighing, weigh as usual, increase weighing).

Participants next reported their use/non-use of a pre-specified list of strategies in: (i) their previous weight loss attempt and (ii) their everyday life when not actively trying to lose weight (akin to maintenance). Strategies included: limiting consumption of certain types of food; reducing snacking; limiting portion sizes; increasing fruit and vegetable consumption; increasing water consumption; switching to diet products; counting calories;

following a specific diet (e.g. 5 : 2); attending a weight loss programme (e.g. commercial or health service); cooking more meals from scratch; reducing the frequency of eating out; eating smaller but more frequent meals; changing the timing of meals; reducing alcohol consumption; medication (prescription or other); and bariatric surgery (the latter two assessed for weight loss only)⁽²³⁾. For physical activity, they indicated whether they had become more active in everyday life, engaged in purposeful physical activity, attended a gym/fitness class/personal training sessions and decreased the amount of time spent sitting down.

Participants also completed the binge eating disorder screening measure from the Patient Health Questionnaire⁽⁵¹⁾ to provide prevalence estimates for loss of control and binge eating (defined as eating an unusually large amount of food in a discrete period of time). This scale has been used extensively in nonclinical samples and shows good sensitivity and specificity to disordered eating behaviours^(52,53).

Statistical analysis

Analyses were conducted using SPSS⁽⁵⁴⁾. Initial descriptive statistics are provided for the whole sample irrespective of percentage weight loss achieved, although participants with implausible values for the duration of the weight loss attempt were excluded (attempt lasting <1 week or >5 years), resulting in the exclusion of 63 participants (1937 participants retained). For descriptive purposes, respondents were classified as having maintained clinically significant weight loss ($\geq 5\%$ loss; i.e. $\leq 95\%$ of start weight) or not⁽⁴¹⁾. To ensure that weight loss cut-offs accorded with those used in previous research, post-hoc exclusion criteria were applied such that participants with <5% weight loss were not included in WLM inferential analyses, in line with the definition of clinically significant weight loss, resulting in the inclusion of 1272 participants in these analyses. WLM was operationalised as a continuous variable: the change from participant's lowest weight (kg) to the weight after any regain had occurred (unstandardised residualised change score). The WLM variable was calculated in this way to avoid multicollinearity and was approximately normally distributed. Ordinal-level data (lifetime number of weight loss attempts, self-weighing frequency) were dichotomised according to features of the distribution, as was the duration of the previous attempt (using a median-split).

Univariate relationships between WLM and putative predictors were assessed using Pearson's correlations and independent samples *t*-tests. A significance threshold of $P < 0.01$ was applied to correct for multiple comparisons. Differences in WLM according to the response to weight

regain were assessed using a one-way analysis of variance with pairwise contrasts. The proportion of participants using each strategy for weight loss, WLM, both, or neither, was calculated.

A multiple linear regression analysis was conducted to examine the predictors of WLM. Previous research to guide specific hypothesis testing is lacking and so all relevant variables were entered together in Step 1 using the Enter function. These included: age, gender, country (dummy-coded, with Denmark as the reference category), number of lifetime weight loss attempts, preweight loss weight (kg), amount of weight loss (kg), time since the end of the attempt (i.e. duration of regain), duration of the previous weight loss attempt, presence versus absence of a lapse during the previous attempt, frequent versus infrequent/absent loss of control and binge eating, use versus non-use of *any* physical activity maintenance strategy, self-weighing frequency, and the total number of dietary strategies used in maintenance (of nine that were related to WLM in univariate analyses). A significance threshold of $P < 0.05$ was used. Regarding the assumptions of linear regression, the residuals were found to be normally distributed (inspected via histogram), variance inflation factor values were within acceptable ranges (1.05–1.85) and the assumption of homogeneity of variance was met (inspected via scatterplot of standardised predicted values against standardised residuals).

Results

The sample ($N = 2000$) comprised approximately equivalent numbers of men ($n = 1021$) and women ($n = 979$). The mean current BMI and highest BMI in the last 12 months fell in the obese range (see the Supporting information, Table S2). Based on highest BMI (the inclusion criterion), 55.4% of the sample were classified as overweight and 44.6% were classified as obese (class I: 30–34.9: 26.9%; class II: 35–39.9: 11.3%; class III: >40: 6.5%)⁽⁴²⁾.

Characteristics of the completed weight loss attempt

The mean (SD) weight loss for the sample after implausible attempt duration data were excluded ($n = 1937$) was 9.1% (7.6%) of their starting body weight (range 0.4–53.8%) or 8.7 kg (SD = 8.9 kg, range 0.5–118.8 kg), which equates to a mean (SD) loss of 0.7 (1.7) kg per week of the attempt. Roughly equivalent proportions of the whole sample reported weight loss of <5% of their body weight (34.3%), 5–10% (30.6%) or >10% (35.1%). Most people (66.2%) had attempted weight loss on their own, without any outside help or support, 18.4% had received professional support and 15.4% used self-help

materials (e.g. Internet or book). The median time between completing the weight loss attempt and taking the survey was 21.7 weeks (interquartile range = 34.7). The completed weight loss attempt ended fewer than 6 months prior to taking the survey for most people (64.1%) but 9.1% reported a completed attempt ending 6–12 months prior and 26.8% reported a completed attempt ending more than 1 year prior.

Of the 1272 participants with $\geq 5\%$ weight loss who were included in WLM analyses, 88.5% regained at least some of the lost weight. The mean (SD) regain was 8.3 (9.0) kg (range = 0–121) or 76.0% (71.1%) of the weight that was lost (range = 0–660%). Following any regain, participants were between 49.4% and 159.6% of their starting weight. On average, they remained 3.7% below their starting weight [i.e. regained to 96.3% (9.0%) of their starting weight]. Maintenance of clinically significant weight loss ($\leq 95\%$ of starting weight after regain) was reported by 40% ($n = 508$) of those who achieved it (i.e. 25.4% of the full sample of 2000) and, at the time of completing the survey, 458 of these had maintained it for at least 1 month (i.e. 22.9% of the full sample).

Strategies used in weight loss and weight loss maintenance

The proportions of participants using each individual dietary and activity-based strategy for weight loss, WLM, or both are shown in the Supporting information (Fig. S1). The proportion using a strategy for both purposes ranged from 0.4% to 13%. Use of nine of 14 separate dietary strategies in maintenance was associated with better WLM (see asterisks in the Supporting information, Fig. S1); none of the individual physical activity strategies were related to WLM, nor was use of any individual dietary strategy during the completed weight loss attempt associated with subsequent WLM (all $P > 0.05$).

Only 1.6% of the sample ($n = 31$) had undergone bariatric surgery, whereas nine people (0.4%) were currently on the waiting list (assessed for weight loss only). Use of bariatric surgery for weight loss was unrelated to WLM ($P = 0.836$) but was associated with greater weight loss ($\rho = -0.07$, $P = 0.014$): participants using this method lost a mean (SD) of 20.6 (26.5) kg (range 0–118 kg) or 15.1% (14.2%) of their start weight (range 0–53.8%). The study was not powered to directly compare weight loss in participants who used versus did not use bariatric surgery. Around one-fifth of participants ($n = 434$) took weight loss pills of some description during their previous attempt [prescription, e.g. Xenical (Roche, Basel, Switzerland) or metformin: 8%; non-prescription, e.g. Ali (GlaxoSmithKline, Brentford, UK): 10.4%; laxatives: 5.7%; other, e.g. herbal supplement: 14.1%]. Participants who had used any

kind of pill to aid weight loss in their previous attempt had regained more weight than those who did not use pills (see the Supporting information, Table S3).

Factors associated with weight loss maintenance

Univariate analyses, displayed in the Supporting information (Table S3), showed that more successful WLM was associated with lower total weight loss (kg) in the previous attempt, a lower pre-weight loss weight and BMI, and use of more dietary strategies for maintenance (range 0–9 strategies that were related to WLM). Controlling for total weight loss (kg), a higher *rate* of weight loss was related to better WLM, indicating that those individuals who lost less weight in absolute terms, but did it at a faster rate, fared best with WLM.

Independent samples *t*-tests (see the Supporting information, Table S3) showed better WLM in participants whose previous weight loss attempt was shorter (< 13 weeks), did not experience a temporary lapse, used physical activity in maintenance (any versus none) and had made fewer lifetime weight loss attempts (1–9 versus ≥ 10). Self-weighing frequency (daily: 24% versus less than daily: 76%) was unrelated to WLM; participants who weighed themselves more frequently were more likely to report having experienced a temporary lapse ($\rho = 0.168$, $P < 0.001$). Significant differences in WLM were observed according to the behavioural response to regain ($F = 7.5$, $P = 0.001$): participants who reported continuing to weigh themselves as usual had better WLM than those who either avoided ($t = 3.3$, $P = 0.001$) or increased the frequency of self-weighing ($t = 2.6$, $P = 0.009$), with no difference between the latter two groups ($P = 0.284$).

Predicting weight loss maintenance

Multiple regression analysis showed that significant predictors of better maintenance included lower weight loss (kg), a shorter time since the end of the previous attempt, not having experienced a lapse, absent/infrequent loss of control and binge eating (versus frequent) and the use of more WLM dietary strategies (see the Supporting information, Table S4). Age, gender, country, number of lifetime weight loss attempts, pre-weight loss weight, duration of the previous attempt, self-weighing frequency and use of physical activity in WLM did not contribute unique variance to the model. Overall, the model accounted for 33.8% of the variance in WLM ($F = 42.69$, $P < 0.001$).

Discussion

The present study examined the prevalence and correlates of self-reported WLM after recent weight loss in

representative population samples of European adults with overweight or obesity from three countries. Just under one-quarter of the sample reported maintaining clinically significant weight loss ($\geq 5\%$) for at least 1 month at the time of survey completion, comprising 40% of those who achieved it. This is comparable to longer-term findings in Germany⁽¹³⁾ and the USA⁽¹¹⁾, where around one-fifth of participants reported maintenance of $\geq 10\%$ WL at 12 months. However, the direct comparability of the findings of the present study to previous research is limited by our focus on maintenance of more recent weight loss (based on inclusion criteria requiring a WL attempt in the past 12 months). The prevalence of short-term WLM reported in the present study is encouraging and adds to existing evidence that WLM is more prevalent in general population samples of overweight and obese individuals than is typically assumed⁽¹⁰⁾.

Variables associated with successful WLM in the present study included the absence of a temporary lapse (small regain) during the weight loss attempt, the absence of frequent loss of control and binge eating, and use of more dietary strategies in maintenance. These contributed to variance in WLM beyond specific features of the weight loss attempt, although contributions of individual predictors were small, in common with most previous studies^(31,41). The finding that a weight lapse during the previous attempt predicted poorer subsequent WLM is consistent with previous findings suggesting that lapses are hard to recover from and often lead to a more significant relapse⁽⁵⁵⁾. Demographic factors, including gender and country of residence, did not predict WLM outcomes, in keeping with a large body of previous research⁽³¹⁾.

Although frequency of self-weighing was not associated with better WLM, participants who weighed themselves more frequently were more likely report a temporary lapse. This may support the suggestion that self-monitoring leads to greater awareness of weight change or, alternatively, may reflect increased self-monitoring in response to the relapse itself. The lack of relationship between self-weighing and WLM is contrary to previous findings in trial-based samples⁽¹⁶⁾ and members of the US weight control registry⁽³⁶⁾. In these samples, the rationale for self-monitoring of weight outcomes (i.e. detecting and reversing small regains) was explicitly stated either to participants⁽¹⁵⁾ or by participants⁽¹⁹⁾. By contrast, *ad libitum* weighing in general population samples is unlikely to be naturally underpinned by this maintenance-specific rationale⁽⁵⁶⁾ and may thus be of lesser importance for maintenance in this context.

Loss of control and binge eating have both been associated with weight regain in clinical/RCT samples^(29,33) and the findings of the present study indicate that their

role extends into general population samples. Previous research has linked a wide array of specific WLM strategies to WLM success, including reducing portion size^(16,40), meal planning and calorie/fat counting⁽³⁸⁾. Although different skillsets may be needed for weight loss and WLM, it is improbable that small numbers of specific, isolated strategies hold the key to WLM for all individuals⁽⁵⁷⁾. Rather, actively and consistently using WLM strategies (versus passive or intentional disengagement from weight control) may help ensure that regain is limited or averted⁽⁵⁸⁾. The negative relationship between the use of weight loss pills and WLM may also speak to this distinction because pills are intended for short-term use and are unlikely to achieve sustained success on their own. No other dietary weight loss strategy was associated with WLM, again suggesting that maintenance outcomes depend more upon strategy use in the maintenance phase than the method of initial weight loss.

Several univariate predictors of WLM no longer functioned as such in the multiple regression, including pre-weight loss weight, number of lifetime weight loss attempts and use of physical activity in WLM. The role of pre-weight loss weight is unclear from the previous literature and number of weight loss attempts appears not to predict WLM⁽³¹⁾. In contrast to a large body of previous research, use of physical activity was unrelated to WLM in the multiple regression⁽³¹⁾. Covariance between use of dietary strategies and physical activity for WLM may have eliminated the significance of physical activity in the regression model. Methodologically, the lack of specificity regarding the frequency and duration of activity also may have contributed to this null effect.

Strengths and limitations

The limitations of the present study include a reliance upon self-report data for weight and height because they tend to be under- and over-reported, respectively⁽⁵⁹⁾. This may be particularly so for the respondents who did not regularly weigh themselves. Higher mean weight losses were observed than are typically found in commercial programmes⁽⁴¹⁾, which may suggest that misreporting extends to weight loss and regain. Objectively measured weight and height is undoubtedly preferable for accuracy, yet it is impractical to obtain at scale and across nations from community samples. Some 82% of the reported weight losses occurred outside a formal (e.g. commercial) setting and so alternate methods for accessing objective weight data are limited; the US NWCR⁽¹⁸⁾ and previous international population-based studies⁽¹⁴⁾ have previously utilised questionnaire self-report methods to effectively capture WLM at scale. The decision to apply a cut-off of $\geq 5\%$ for clinically significant weight loss,

although consistent with most previous research, may well have unhelpfully excluded individuals with an initial BMI at or near 25 kg m^{-2} who attained a healthy-range BMI with weight loss $<5\%$.

An important limitation is the exclusion of individuals without a *recent* weight loss attempt, which removed those who may have lost weight and maintained it over the longer-term, with no need to resume weight loss efforts. The rationale was to make accurate reporting of features of the latest weight loss attempt more likely and to obtain novel data on factors in WLM during the period proximal to the weight loss attempt, although this decision has clear implications for prevalence estimates. Another limitation is the use of (high-quality) non-probability online panels rather than probability-based panels for data collection. Country-specific representative stratified sampling frames were applied⁽⁴⁵⁾ and panel participants were recruited from online and offline sources⁽⁴⁸⁾, ensuring that data were obtained from key demographic groups and resulting in a final sample whose gender and age-based proportions resembled those of the census-based population from which it was drawn (see the Supporting information, Table S1). However, the composition of the general population of individuals with overweight or obesity who have made a recent weight loss attempt is unknown and so it is not possible to say whether the study sample accurately represented this group. The study benefited from a large population-based European sample, the inclusion of only individuals with current or previous overweight or obesity, a broadly equal representation of men and women, and an explicit focus on WLM, all of which increase its ecological validity. Our findings add to the existing body of research by providing data from a largely un-reached population of Europeans attempting weight loss outside the structure provided by a commercial programme or weight loss RCT. Our findings also usefully add to the limited number of studies focusing specifically on strategies for WLM versus strategies for weight loss⁽⁷⁾.

Conclusions

The present study captured the prevalence of WLM following recent weight loss, as well as the variables associated with successful WLM, in a sample of Europeans with overweight or obesity from several countries. It provided insights into naturalistic patterns of weight loss and regain outside of structured contexts, although objective weight data and information on longer-term WLM were lacking. The findings have implications for the design of population-based WLM interventions, such as the provision of strategies aiming to combat loss of control and binge eating, and the continued and consistent use of weight

maintenance strategies beyond the period of active and deliberate weight loss, particularly in the presence of a lapse, to prevent further regain.

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Conflicts of interest, source of funding and authorship

The authors declare that they have no conflicts of interest.

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FFS, RJS, PJT and BLH conceived the overall NoHoW project and secured funding. EHE, KS and FFS designed the survey in English with input from MMM, IS, SP, LL, PJT, RJS and BLH. MMM, IS and PJT translated the survey into Portuguese. SP and LL translated the survey into Danish. EHE and KS liaised with the market research company to recruit the sample, analysed the data and drafted the paper. All authors read and provided feedback on the paper and approved the final version submitted for publication.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. Proportions of participants using individual dietary strategies for weight loss, weight loss maintenance, or both, and relationship with self-reported maintenance.

Table S1. Age and gender composition of the study sample ($N = 2000$) compared to the composition of the census-based stratified sampling frame.

Table S2. Descriptive characteristics of the study sample ($N = 2000$).

Table S3. Relationships with self-reported weight loss maintenance.

Table S4. Regression analysis of weight loss maintenance (WLM) upon its putative predictors amongst participants with self-reported weight loss of $\geq 5\%$ ($N = 1272$).