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BRIEF REPORT

Weight control behaviors of highly successful weight loss maintainers: the Portuguese Weight Control Registry

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Abstract To describe key behaviors reported by participants in the Portuguese Weight Control Registry and to determine associations between these behaviors and weight loss maintenance. A total of 388 adults participated in this cross-sectional study. Assessments included demographic information, weight history, weight loss and weight maintenance strategies, dietary intake, and physical activity. Participants lost on average 18 kg, which they had maintained for ~28 months. Their average dietary intake was 2199 kcal/day, with 33 % of energy coming from fat. About 78 % of participants engaged in levels of moderate-plus-vigorous physical activity exceeding 150 min/week (51 % above 250 min/week), with men accumulating 82 more minutes than women ($p < 0.05$). The most frequently reported strategies for both weight loss and maintenance were keeping healthy foods at home, consuming vegetables regularly, and having daily breakfast. Greater weight loss maintenance was associated with higher levels of physical activity, walking, weight self-monitoring, establishing specific goals, and with reduced portion size use, reduced consumption of carbohydrates, and increased consumption of protein, ($p < 0.05$). Results indicate that weight loss maintenance is possible through the adoption of a nutritionally-balanced diet and regular participation in physical activity, but also suggest that adopting different (and, to a degree, individualized) set of behavioral strategies is key for achieving success.

Keywords Weight loss · Weight maintenance · Strategies · Behaviors · Weight Control Registry

Introduction

Long-term weight loss maintenance is a critical yet elusive goal for many individuals (Stevens et al., 2006). Interventions combining diet, exercise, and behavior change strategies show some success but weight lost is typically regained within a few years (Powell & Calvin, 2007). However, up to 20 % of individuals with excess weight are able to lose at least 5 % of their initial body weight and maintain it for many years (Wing & Hill, 2001). The US National Weight Control Registry (NWCR) is one of the richest databases detailing the characteristics of successful weight loss maintainers, highlighting a number of psychological and behavioral factors which may serve as guidance for others attempting to lose weight (Catenacci et al., 2008; Ogden et al., 2012). With the exception of Germany (Feller et al., 2015), Portugal is presumably the only other nation with a comparable weight control registry (Vieira et al., 2012, 2014). The Portuguese Weight Control Registry (PWCR) was established in 2008 and consists of an ongoing voluntary registry of adults who have been successful at losing at least 5 kg and have kept it off for 1 year or more. Despite the specificities of each registry regarding the minimum amount of weight loss for eligibility [13.6 kg in the NWCR; 10 % in the German Weight Control Registry (GWCR)], all registries were set with the

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same goal of studying long-term successful maintenance of weight loss. The PWCR allows the investigation of characteristics and mechanisms behind successful weight loss maintenance in the Portuguese population. Given that social, environmental and cultural influences are thought to contribute to obesity (Heitmann et al., 2012), studying successful weight loss maintainers from different populations may provide further insights into weight loss and maintenance-related processes in general, while also be informative to guide interventions and policy in that specific country and environment. The purpose of this brief report is to describe the dietary intake and physical activity behaviors of the current group of PWCR participants, report on their use of specific strategies, and analyze associations between weight control behaviors and weight loss maintenance. Because weight control behaviors may differ between men and women (Kiefer et al., 2005), gender differences were also tested.

Methods

Subjects

Recruitment strategies included a PWCR website, a PWCR Facebook page, and local and national media coverage and advertisements. Interested individuals were invited to contact the research team by telephone or e-mail or to register online. This registration included a screening questionnaire with information on personal weight history, to determine whether they meet the eligibility criteria. To be eligible for enrolment in the registry, individuals had to have Portuguese nationality, be aged between 18 and 65 years, and have maintained at least a 5 kg intentional weight loss for at least 1 year (independently of their initial body weight). This weight loss criterion was chosen because (1) in Portugal, a 5 kg weight loss represents more than 5 % weight loss for most overweight individuals [based on Carmo et al., 2008; Sardinha et al., 2012)], and the guidelines for the management of overweight and obesity in adults show that a sustained weight loss of 3–5 % is likely to result in clinically meaningful health benefits (Jensen et al., 2014); (2) 5 kg represents a realistic weight loss goal for many individuals involved in lifestyle weight management interventions (e.g., Teixeira et al., 2010); and (3) 5 kg is a clear and recognizable number for advertisement and recruitment purposes. To further ensure eligibility criteria, individuals were asked to provide the contact of a health professional, family member, or friend who could confirm their weight loss.

Individuals who met the eligibility criteria were then invited to visit the Exercise and Health Laboratory of the Faculty of Human Kinetics, University of Lisbon, for assessments. If they were not able to visit the University facilities, a (partial) battery of questionnaires was sent by mail. A written informed consent was obtained before any assessment. To date, 388 individuals (64 % women) enrolled in the registry, of which 225 have completed laboratory assessments. There were no differences in the demographic characteristics between those who completed laboratory assessments and those who completed mailed questionnaires.

It should be noted that for the PWCR to have the same number of participants as the US NWCR [using as relative proportion the number of obese adults in both countries (WHO Global Infobase, 2016)], it would have to recruit approximately 71 participants. Currently, the number of PWCR participants is nearly five times higher suggesting a level of representativeness at least comparable, if not superior, to the US study. Unfortunately, the study population under scrutiny—nationwide successful weight loss maintainers—has not been quantified in either the US or Portugal.

Assessments

Upon entering the PWCR, participants completed a questionnaire with standard demographic information, details about weight history, and specific weight loss and weight maintenance strategies which included a series of statements about dietary habits (e.g., "consumed vegetables", "included healthy snacks in between meals") and other behaviors (e.g., "self-monitored body weight", "used stairs rather than the elevator") answered on a 5-point Likert scale (1 = never to 5 = always) (see Supplementary material 1 for a detailed description of the weight loss and maintenance strategies). In the laboratory, weight and height were measured according to standard procedures (World Health Organization, 1995). Using current weight and the maximum previous weight (self-reported), current and maximum body mass index (BMI), and the magnitude of weight loss were calculated. Dietary intake was assessed using a previously validated (Lopes, 2000; Lopes et al., 2007) semi-quantitative food-frequency questionnaire. Physical activity was assessed using the widely-used Paffenbarger Physical Activity Questionnaire (PPAQ) (Paffenbarger et al., 1978), and through accelerometry in a sub-sample (see Supplementary material 2 for information on assessment instruments). There were no differences in the demographic characteristics between those who wore an accelerometer and those who did not. The study was approved by the Ethics Committee of the Faculty of Human Kinetics, University of Lisbon.

Statistical analysis

Statistical analyses were carried out using IBM SPSS version 22. Significance level was set at $p < 0.05$ for all tests. Independent-sample t tests for continuous variables and Chi-square tests for categorical variables were used to compare gender differences. McNemar's test was used to compare weight loss and weight maintenance strategies. To test the moderation effect of gender on the association between percentage of weight lost and dietary intake-related variables, physical activity-related variables, and weight loss and weight maintenance strategies, univariate General Linear Models were conducted. Homogeneity of variance and normality of residuals were tested. Because residuals were not normal, the dependent variable (percentage of weight lost) was transformed using a logarithmic function (natural logarithm), bringing each model into compliance with the assumptions of General Linear Models. If there was a significant interaction effect, the sample was stratified by gender and Pearson correlations were performed to examine associations within each group; if the interaction effect was not significant, partial correlations were used to explore these associations while controlling for gender. Since variability is common among physical activity and nutritional variables, only the most extreme values (outliers = mean ± 4 SD) were excluded from analyses.

Results

On average, participants were 39 years old, and most were married and had completed higher education (Table 1). About 10 % of individuals had normal weight, 24 % were overweight and 66 % were obese before their successful weight loss. Participants lost, on average, 18.3 kg or 18.7 % of initial body weight (men: 19.9 %; women: 17.8 %; $p > 0.05$). After weight loss, 39 % of participants had normal weight, 42 % were overweight and 19 % were obese. PWCR members reported, on average, having maintained the weight loss for ~28 months.

Participants reported an average dietary intake of 2199 kcal/day (with men consuming ~230 kcal more than women, $p < 0.05$), with 19.4 % of energy coming from protein, 47.4 % from carbohydrates, and 33.2 % from fat. Daily fiber intake was, on average, 30.5 g. PWCR' participants reported 292 ± 267 min/week of moderate-plus-vigorous physical activity (MVPA, $p = 0.025$ favoring men) (see Table 1). In a sub-sample of participants (n = 168), objectively measured MVPA was 284 ± 170 min/week (men: 321 ± 182; women: 259 ± 157 min/week; $p = 0.019$). There was a large variability in individual MVPA, ranging from 20 min/week to 781 min/week, with 22 % of participants engaging in less than 150 min/week (Fig. 1). Additionally, average sedentary time was 7749 ± 567 min/week (roughly 1107 min/day including sleeping time).

Overall, the most frequently reported weight loss and maintenance strategies were *having healthy foods available at home*, *consuming vegetables* and *eating breakfast daily* (see Supplementary material 1). More participants reported *selecting foods consciously*, *reducing portions size*, *establishing specific goals*, *reducing the consumption of foods rich in carbohydrates, decreasing meals at restaurants*, *recording dietary intake and/or physical activity*, *counting calories*, and *consuming weight loss supplements* and *meal substitutes* for weight loss, while for weight loss maintenance more participants reported *having healthy foods available at home*, *eating breakfast daily*, *consuming fiber-rich foods,* and *increasing the consumption of protein-rich foods* ($p < 0.05$).

To achieve weight loss, there were significant gender differences for *establishing specific goals* ($p = 0.012$, favoring men) and *reducing culinary fat* ($p = 0.014$, favoring women). To maintain weight, more men engaged in *regular physical activity* and *recorded their dietary intake and/or physical activity* ($p < 0.001$), and more women *included healthy snacks in between meals*, *reduced portions size* and *decreased meals at restaurants* ($p < 0.05$).

Gender significantly moderated the association between percentage of weight loss maintenance and energy intake[1] ($p = 0.018$), protein intake ($p = 0.001$), *reducing sugary foods* as a weight *loss* strategy ($p = 0.004$), *having healthy foods available at home* as a weight *maintenance* strategy ($p = 0.009$) and *keeping dietary intake and/or physical activity records* for both weight *loss* ($p = 0.048$) and weight *maintenance* ($p = 0.039$). After splitting the sample, the percentage of weight loss maintenance was positively associated with protein intake ($r = 0.28$, $p = 0.004$), *reducing sugary foods* as a weight *loss* strategy ($r = 0.27$, $p = 0.004$), *having healthy foods available at home* as a weight *maintenance* strategy ($r = 0.20$, $p = 0.031$), and *keeping dietary intake and/or physical activity records as* a weight *maintenance* strategy ($r = 0.30$, $p = 0.001$) only in women. Additionally, after controlling for the effect of gender, positive significant associations were observed between percentage of weight loss maintenance and MVPA (by accelerometry, $r = 0.20$, $p = 0.015$), *monitoring weight* ($r = 0.14$, $p = 0.049$), and *walking instead of driving/taking public transportation* ($r = 0.18$, $p = 0.011$) for *losing* weight; *reducing portions size* ($r = 0.26$, $p < 0.001$) for *maintaining* weight; and *establishing specific goals* ($r = 0.20$, $p = 0.006$; $r = 0.23$, $p = 0.001$),

[1] Energy intake adjusted for initial body weight before weight loss (expressed in energy/kg/day).

Table 1 Participants' characteristics

	All	Men	Women
Demographic	(n = 388)	(n = 142)	(n = 246)
Age	39.0 ± 11.1	40.2 ± 11.0	38.3 ± 11.1
Education (%)			
Junior high or bellow	8.9	10.7	7.9
High school	22.0	21.4	22.3
University degree	69.1	67.9	69.8
Marital status (%)			
Single	33.4	25.0	38.2
Married/union	54.6	65.0	48.8[b]
Divorced/widow	12.0	10.0	13.0
Weight history	(n = 225)	(n = 88)	(n = 137)
Maximum weight (kg)	92.5 ± 20.4	104.6 ± 19.4	84.4 ± 16.8[a]
Maximum BMI (kg/m^2)	33.1 ± 6.4	34.7 ± 5.9	32.0 ± 6.5[b]
Current weight (kg)	74.1 ± 13.4	82.3 ± 11.5	68.7 ± 11.7[a]
Current BMI (kg/m^2)	26.6 ± 4.2	27.3 ± 3.6	26.2 ± 4.5[c]
Weight loss (kg)	18.3 ± 12.5	22.1 ± 14.2	15.8 ± 10.6[b]
Maintenance (months)	28.3 ± 29.6	27.4 ± 22.7	28.9 ± 33.5
Dietary intake			
Energy (kcal/day)	2199 ± 840	2341 ± 867	2108 ± 813[c]
Protein (% kcal/day)	19.4 ± 3.6	19.4 ± 3.5	19.4 ± 3.6
Carbohydrates (% kcal/day)	47.4 ± 7.6	47.1 ± 6.8	47.6 ± 8.0
Fat (% kcal/day)	33.2 ± 6.5	33.4 ± 5.7	33.0 ± 7.1
Dietary fiber (g/day)	30.5 ± 13.7	31.6 ± 15.6	29.9 ± 12.4
Physical activity			
MVPA (min/week)	292 ± 267	341 ± 279	259 ± 255[c]

Data reported as mean ± S.D.; [a] $p < 0.001$; [b] $p < 0.01$; [c] $p < 0.05$; (Independent-sample t test for between-group comparisons)

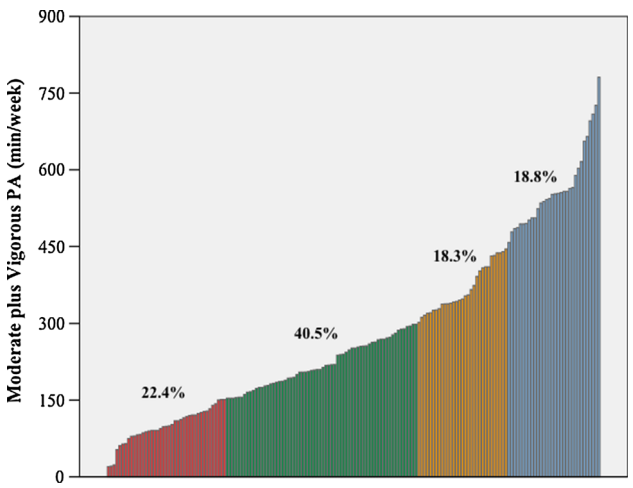

Fig. 1 Minutes of moderate-plus-vigorous physical activity per week, measured by accelerometry. *Bars* represent individual participants. *Different colors* indicate thresholds of 150, 300, and 450 min/week

reducing the consumption of carbohydrates-rich foods ($r = 0.21$, $p = 0.003$; $r = 0.20$, $p = 0.006$), and *increasing the consumption of protein-rich foods* ($r = 0.18$, $p = 0.013$; $r = 0.15$, $p = 0.033$) for weight *loss* and weight *maintenance*, respectively. *Consuming weight loss supplements* as a strategy for *maintaining* weight was negatively associated with the percentage of weight loss maintenance ($r = -0.15$, $p = 0.039$).

Discussion

This is one of the first studies outside of North America to describe the characteristics of individuals who are successful at losing *and maintaining* weight loss. On average, participants had lost about 18 kg (19 % of their initial body weight) and had maintained this weight loss for about 28 months. Before losing weight, the majority of PWRC members was obese; after their weight loss, about 80 % were placed in the overweight or normal weight category.

The dietary pattern of the average PWCR participant generally meets the Acceptable Macronutrient Distribution Ranges recommended for the population (10–35 % protein, 45–65 % carbohydrates, 20–35 % total fat) (Institute of Medicine, 2005). Similar results were found in the NWCR

participants, although they reveal a higher intake of carbohydrates and a lower intake of fat (Phelan et al., 2006). In the PWCR, fat represented a considerable proportion of the daily energy intake in both men and women (33 %), potentially due to the typical Mediterranean diet in Portugal, which is rich in olive oil. Another characteristic of this diet is that it provides a substantial amount of fiber-rich foods and the average participant clearly passed the recommended value (e.g., 25 g fiber/day, European Food Safety Authority [EFSA Panel on Dietetics Products, Nutrition, and Allergies, 2010)]. Higher protein intake [which improves satiety (Paddon-Jones et al., 2008)] was positively associated with the percentage of weight loss maintenance in women, in line with previous studies [e.g., (Westerterp-Plantenga et al., 2004)].

Regarding physical activity, the average PWCR member engaged in a relatively high level of MVPA (284 min/week or roughly 40 min/day), meeting the ACSM's recommended levels for weight loss maintenance (>250 min/week) (Donnelly et al., 2009). Importantly, partial correlation analyses also showed a positive association between minutes of MVPA and the magnitude of weight loss maintenance, independent of gender. These results are in line with findings from the US registry showing physical activity as a key strategy for long-term weight control (Ogden et al., 2012). However, it should be noted that there is a sizable group of participants who was able to lose and maintain weight with less than 250 min/week of MVPA, indicating that the amount of physical activity necessary to achieve energy balance is highly individual. These findings suggest that physical activity prescription in real contexts should move beyond generalized guidelines (e.g. 250 min/week as a fixed target) and consider individual characteristics (Teixeira, et al., 2011).

Participants adopted a large range of strategies to reduce and maintain weight. Some strategies were more consistently associated with success in women such as reducing sugary foods for weight loss, and having healthy foods available at home and recording dietary intake and physical activity for weight loss maintenance. This notwithstanding, other strategies were associated with success independent of gender, including monitoring weight and walking instead of taking transports for weight loss, and reducing portions size for weight loss maintenance. Importantly, establishing specific goals, reducing the consumption of carbohydrates-rich foods and increasing and protein-rich foods seem to be key for success in both weight loss and maintenance. Using weight loss supplements (used by a tenth of participants) was negatively associated with weight loss maintenance, perhaps because this could mitigate the use of other healthier and more successful strategies or individuals might start to use this strategy when they experience weight gain. The variety of strategies adopted suggests that there is no "one size fits all" approach for weight loss and maintenance. This was illustrated in a recent study from the NWCR (Ogden et al., 2012) where several distinct profiles of success were identified.

Finally, it is noteworthy that most of the strategies highly used by the PWCR members to *lose* weight were maintained in the long run. The limitations of the cross-sectional analysis notwithstanding, these results suggest that long-term weight management may consist of a continuous process of behavior change, perhaps involving similar behaviors and predictors, instead of being two separate processes (i.e., loss *and* maintenance). Alternatively, this could indicate that, while reporting that they are in weight loss maintenance, participants could still wish to lose additional weight. To the extent this occurs, it could also explain a similarity in responses to weight loss versus weight maintenance strategies.

In summary, this manuscript provides novel information regarding dietary and physical activity patterns and behavioral strategies contributing to long-term weight loss maintenance of Portuguese individuals. With this data, there is now evidence in different countries to suggest that individuals can be successful at losing weight and keeping it off, through a number of different (and, to a degree, individualized) set of behavioral strategies, which should be considered in weight management interventions. Considering the generalized assumption that long-term weight control is rare and exceedingly difficult, an important implication from these collective findings is that such thinking is not at par with reality and that interventions, small and large, can continue to be improved with the aim of increasing the number of individuals who reach the level of success reported by "losers" in these studies. Further exploration of the lifestyle patterns of Portuguese successful weight loss maintainers, through profiling methodologies, could be useful for tailoring future weight management interventions to the specific characteristics or profiles of individuals wishing to lose weight and therefore improve long-term results in obesity treatment.

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Compliance with ethical standards

Conflict of interest Authors Inês Santos, Paulo N. Vieira, Marlene N. Silva, Luís B. Sardinha, and Pedro J. Teixeira declare that they do not have any conflict of interest.

Human and animal rights and Informed consent All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

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