

Breakfast consumption and weight-loss maintenance: results from the MedWeight study

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Abstract

Daily breakfast consumption is a common eating behaviour among people who have maintained their weight loss after weight-loss management. However, there is not a precise definition for breakfast in the literature. The purpose of this study was to investigate potential associations between breakfast consumption (based on several definitions) and weight-loss maintenance, as well as to explore differences in breakfast quality between individuals who managed to maintain part of the weight loss and in those who regained weight loss. The study sample consisted of 354 participants of the MedWeight study (age: 32 (sd 10) years, 61% women) who had lost $\geq 10\%$ of their initial body weight and either maintained the loss for ≥ 1 year (maintainers, n 257) or regained weight loss (regainers, n 97). Participants completed online questionnaires and reported their dietary intake through two telephone 24-h recalls. Breakfast consumption was evaluated using twelve different definitions. The analysis indicated that breakfast consumption was associated with weight-loss maintenance only in men, when using self-reported breakfast consumption or the following breakfast definitions: (1) the first eating episode consumed at home and (2) the first eating episode consumed at home excluding caffeinated drinks. This association remained statistically significant even after adjustment for potential confounding factors. Thus, breakfast, the first eating episode of the day, when consumed at home, may be protective against weight regaining.

Key words: Breakfast consumption: Meal patterns: Weight-loss maintenance: Obesity

Breakfast has been widely advocated as an important part of a healthy diet and as an effective strategy for achieving and maintaining a healthy weight^(1,2). However, supporting evidence is not as strong as one may believe^(3,4). Epidemiological data have associated breakfast skipping with increased risk of obesity in both children⁽⁵⁾ and adults⁽⁶⁾, and have associated breakfast consumption with reduced risk of weight gain⁽⁷⁾. In addition, the percentage of total energy intake consumed at breakfast is negatively associated with weight gain⁽⁸⁾, and daily breakfast consumption is a common behaviour among weight-loss maintainers⁽⁹⁾. Despite these findings, results from clinical trials tend to be conflicting. A recommendation to eat or skip breakfast failed to achieve a detectable effect on weight loss in free-living adults who were attempting to lose weight⁽¹⁰⁾. However, it has been shown that high energy intake at breakfast combined with low energy intake at dinner can lead to greater weight loss as compared with the opposite pattern⁽¹¹⁾. To add to the conflicting data, another clinical trial showed that a high-energy breakfast had no better effect on weight loss than a high-energy dinner did, but those who consumed a high-energy breakfast had better weight-loss maintenance outcomes compared with those consuming a high-energy dinner⁽¹²⁾.

These contradictory results may be, at least partly, explained by the variety of breakfast definitions used in the related literature. Nevertheless, there is limited consensus as to what constitutes the term breakfast meal⁽¹³⁾. Breakfast meal has been

defined by weekly frequency, time of day, timing in relation to waking and daily activities, types of food or beverages consumed or amount of energy provided⁽¹⁴⁾. The lack of a standard definition means that measurement of breakfast consumption in research is subject to either participants' interpretations of what constitutes breakfast or varied definitions provided by researchers⁽¹⁴⁾.

Thus, we reviewed the relevant literature for the definitions of breakfast, and applied those used more commonly on people who lost weight and maintained (maintainers) or regained (regainers) the loss. Our purpose was to examine whether breakfast consumption, and specifically which type of breakfast, is associated with weight-loss maintenance. In addition, we aimed to study the quality of the breakfast meal both in maintainers and regainers.

Methods

Study design and sample

The current analysis included 354 participants from the MedWeight, a registry of people who lost weight and maintained it (maintainers) and people who lost weight but regained the loss (regainers). Full details of the study design have been described elsewhere⁽¹⁵⁾. In brief, inclusion criteria were age between 18 and 65 years, initial BMI of 25 kg/m² or more and

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an intentional loss at least 10% of starting weight. Volunteers maintaining the minimum 10% loss for at least 1 year at study entry were classified as maintainers. Those currently at a weight $\geq 95\%$ of their maximum body weight were classified as regainers. Individuals with a current body weight between 90 and 95% of their maximum weight were excluded in order to avoid overlapping of groups. Current pregnancy was also an exclusion criterion. Eligible participants completed the study questionnaires, which was available to them through the MedWeight website (<http://medweight.hua.gr>). The study protocol was approved by the Harokopio University Ethics Committee.

From the 354 participants, 257 were maintainers (73%) and ninety-seven were regainers (27%). Descriptive characteristics of the participants are presented in Table 1. Maintainers were younger compared with regainers and achieved greater initial weight loss.

Assessment of dietary intake

Dietary intake was evaluated using the 24-h recall method⁽¹⁶⁾. Participants were asked to report in detail all foods and beverages consumed on the day before (i.e. between waking up in the morning and going to bed at night). Time, location, parallel activities and companions were also recorded for each eating occasion. Two telephone 24-h dietary recalls were performed in each volunteer⁽¹⁷⁾, 10 d apart from each other, with weekdays and weekends proportionately represented among participants. Furthermore, participants did not know when these recalls would be occurring, so they could not change their diet in anticipation of the recall.

Recall data were analysed for energy, macro- and micro-nutrient intake using the dietary analysis software Nutritionist Pro™ (2007, Axxya Systems). In addition, dietary intake was grouped into twenty-seven food groups, featuring the core foods of the Greek diet, as well as food items or groups associated with obesity^(18,19). Portion sizes used were according to the Mediterranean diet pyramid⁽²⁰⁾.

Diet quality was assessed using the MedDietScore, a simple dietary score based on the characteristics of the Mediterranean diet. The score ranges from 0 to 55, and higher values indicate greater adherence to the Mediterranean diet⁽²¹⁾.

Breakfast assessment and definitions

First, we reviewed current literature in order to locate the various definitions of breakfast used previously. A PubMed search was conducted for breakfast-related articles published until December 2013, using “breakfast” as a search term included in the title of the article. In total, 1023 articles were screened and fifty unique definitions of breakfast were identified. These definitions refer to one of the following categories: time of day, timing in relation to waking up and/or daily activities, time combined with energy provided, place of consumption, types of food or beverages consumed, combinations of these categories or self-reported breakfast. As a second step, we applied the most commonly used definitions of breakfast meal from each of the categories, and we also performed additional combinations – that is twelve breakfast definitions in total.

Table 1. Descriptive characteristics according to maintenance status in women and men (Number of maintainers and regainers, mean values and standard deviations)

Variables	Women (n 216)				Men (n 138)			
	Maintainers (n 153)		Regainers (n 63)		Maintainers (n 104)		Regainers (n 34)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (years)	30.7	10.1	35.3	12.2	30.6	8.8	34.2	9.6
Current weight (kg)	68.4	12.5	85.0	17.1	84.0	11.9	103.4	16.0
Current BMI (kg/m ²)	24.9	4.4	30.5	4.6	26.3	3.6	32.3	4.5
Maximum weight (kg)	87.1	17.4	88.3	17.8	109.3	23.3	106.8	15.8
Maximum BMI (kg/m ²)	31.7	6.1	31.6	4.9	34.2	7.5	33.3	4.5
Initial weight loss (kg)	22.8	11.7	14.7	6.2	29.7	17.1	17.4	7.6
Initial weight loss (%)	25.4	8.6	17.2	5.5	26.0	9.2	19.7	8.2
				P*				P*
				0.01				0.03
				<0.001				<0.001
				<0.001				<0.001
				0.49				0.95
				0.49				0.82
				<0.001				<0.001
				<0.001				<0.001

* Mann-Whitney test.

Table 2. Breakfast definitions

Code	Definition
Br1	Anything consumed between 06.00 and 10.00 hours for weekdays or 06.00 and 11.00 hours for weekends ⁽²²⁾
Br2	Anything consumed between 05.00 and 10.00 hours with a combined total energy ≥ 418 kJ (≥ 100 kcal) ⁽²³⁾
Br3	Anything consumed between 05.00 and 10.00 hours for weekdays or 05.00 and 11.00 hours for weekends, excluding caffeinated drinks
Br4	Anything consumed at home ⁽²⁴⁾
Br5	Consumed at home and included at least one solid food
Br6	Anything consumed at home, excluding caffeinated drinks
Br7	Anything consumed before starting daily activities
Br8	Consumed before starting daily activities and included at least one solid food
Br9	Consisting of something more than a glass of milk or fruit juice ⁽²⁵⁾
Br10	Consisting of something more than ready-to-eat cereals ⁽²⁶⁾
Br11	Consumed before starting daily activities, no later than 10.00 hours and of an energy level between 20 and 35 % of total daily energy needs ⁽²⁾

Breakfast was defined by eleven different ways based on the two 24-h recalls. These definitions refer to the first eating episode of the day, taking into consideration the time of day, location, daily activities, types of food or beverages consumed or amount of energy provided. These breakfast definitions are described in Table 2.

Subjects who did not consume breakfast on both days were categorised as breakfast skippers. Subjects who consumed breakfast on one of the 2d were categorised as occasional breakfast eaters, whereas those who consumed breakfast on both days were classified as breakfast eaters⁽²³⁾. Breakfast consumption was also defined based on what a person perceives as a breakfast meal using a single question about breakfast consumption: “how often do you have breakfast?”. Available answers were: “never/rarely”, “1–3 times/month”, “1–2 times/week”, “3–6 times/week” and “7 times/week”. Finally, the first eating episode was analysed in terms of food groups.

Other variables

Information on demographic parameters (age, sex) and anthropometric and weight-related characteristics (current and maximum weight, height, initial weight loss) were obtained through structured questionnaires. Physical activity was assessed by the short version of the International Physical Activity Questionnaire⁽²⁷⁾, translated and validated in the Greek population⁽²⁸⁾. Participants reported all domains of physical activity during the last 7 d.

Statistical analyses

Characteristics of those who maintain the weight loss were compared with those who regained it. For non-normally distributed quantitative variables, the Mann–Whitney test was performed. For categorical data, Pearson’s χ^2 test was used to check for differences between groups. The association between breakfast consumption and maintenance status was also assessed using binary logistic regression models that calculated OR. Model 1 was unadjusted; model 2 was adjusted for age;

model 3 was further adjusted for total energy intake and adherence to the Mediterranean diet; model 4 was adjusted for age, total energy intake and intake of whole grains, fruits, sweets at breakfast meal; model 5 was adjusted for age, total energy intake and daily intake of whole grains, fruits and sweets; and model 6 was adjusted for age, total energy intake, adherence to Mediterranean diet and physical activity. Goodness of fit of the models was tested by the Hosmer and Lemeshow test. Data analysis was carried out using SPSS Statistics 22.0; a *P*-value of 0.05 was considered statistically significant.

Results

Daily energy intake did not differ between maintainers and regainers (7406 (SD 2724) *v.* 7778 (SD 2862) kJ (1770 (SD 651) *v.* 1859 (SD 684) kcal), respectively, *P*=0.142), nor did diet quality, assessed by the MedDietScore (28.3 (SD 6.0) *v.* 28.2 (SD 6.0), respectively, *P*=0.633). These findings were also true when men and women were analysed separately. Physical activity levels differed between male maintainers and regainers (2504 (1253–4893) *v.* 1283 (511–2714) total MET-min/week, respectively, *P*=0.001), whereas no such difference was observed in women (1555 (792–3073) *v.* 1400 (782–2946) total MET-min/week, respectively, *P*=0.001). No differences were observed in sitting hours between maintainers and regainers in both sexes.

With regard to definitions of breakfast meal, the percentage of those consuming breakfast varied from 1.1 to 75.9% in maintainers and from 0 to 61.2% in regainers depending on the definition used. When breakfast was defined based on time of consumption (Br1), 63.8% of maintainers and 61.2% of regainers were classified as regular breakfast eaters. Using a definition based on time of consumption combined with energy content (Br2), the percentages of regular breakfast eaters were 44.2 and 41.8% in maintainers and regainers, respectively, whereas when the types of food consumed were taken into account (Br9) the percentages of regular breakfast eaters were even lower, as merely 21.1% of maintainers and 14.3% of regainers appeared to consume breakfast regularly. None of these between-group comparisons were statistically significant (Fig. 1).

Statistically significant differences between maintainers and regainers were observed only in two definitions of breakfast meal (Figs 1 and 2). Specifically, 74% of maintainers *v.* 60% of regainers consumed breakfast regularly when breakfast was defined by definition Br4 (*P*=0.013). When breakfast was defined as Br7, 76% of maintainers *v.* 57% of regainers were regular breakfast eaters (*P*=0.002). When men and women were analysed separately, female maintainers and regainers differed significantly only in Br7 definition (regular consumption frequencies of maintainers and regainers 77.2 *v.* 57.8%, respectively, *P*=0.013). On the other hand, statistically significant differences in four breakfast definitions (i.e. Br3, Br4, Br6 definitions and self-reported breakfast consumption) were observed in male maintainers and regainers, with maintainers having higher frequencies of regular breakfast consumption. Specifically, frequencies of regular breakfast consumption for male maintainers and regainers were, respectively, 49.5 *v.* 29.4% for Br3 (*P*=0.046), 71 *v.* 38.2% for Br4 (*P*=0.002), 58.9 *v.* 32.3% for Br6 (*P*=0.026) and 56.2 *v.* 36.8% for self-reported daily breakfast consumption (*P*=0.008).

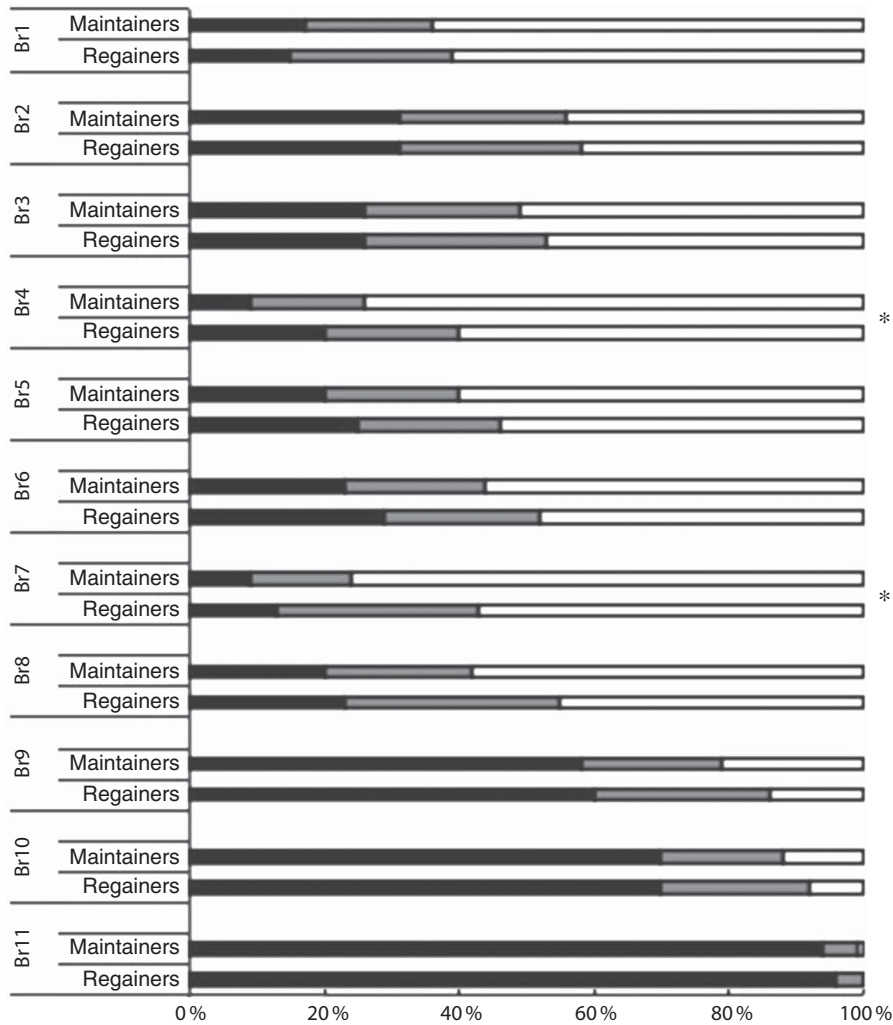


Fig. 1. Breakfast frequency according to maintenance status based on recall data (percentages). Mean values were significantly different at $*P < 0.05$ (Pearson's χ^2 test). ■, Breakfast skippers; ▨, occasional breakfast eaters; □, breakfast eaters.

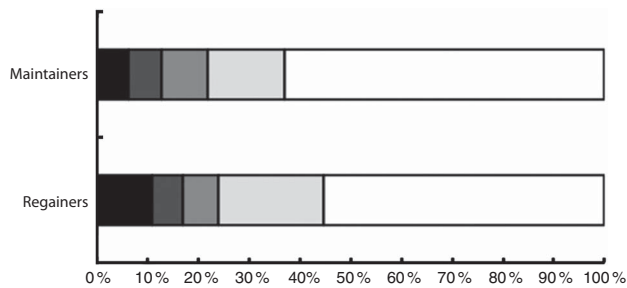


Fig. 2. Self-reported breakfast frequency according to maintenance status (percentages). No statistically significant differences were found ($P = 0.310$, Pearson's χ^2 test). ■, Rarely/never; ▨, 1-3 times/month; ▩, 1-2 times/week; ▪, 3-6 times/week; □, daily.

A logistic regression analysis was performed separately in men and women because of the interaction observed between sex and breakfast consumption. Results from this analysis showed that breakfast defined by Br7 definition was not associated with weight-loss maintenance in women. With regard to men, breakfast defined by Br4 or Br6 definition was associated

with weight-loss maintenance. Specifically, the OR of being a maintainer for men consuming breakfast regularly compared with those skipping breakfast were 4.59 (95% CI 1.72, 12.30, $P = 0.03$) and 3.08 (95% CI 1.24, 6.68, $P = 0.03$) according to the above definitions, respectively. Self-reported breakfast consumption was also associated with weight-loss maintenance. The OR of being a maintainer among men consuming breakfast 1-2 times a week compared with those consuming breakfast rarely or never were 9.50 (95% CI 1.50, 60.11, $P = 0.01$), respectively. The association between the aforementioned breakfast definitions and weight-loss maintenance remained statistically significant after adjustment for age, total energy intake and adherence to Mediterranean diet; or for age, total energy intake and whole grain, fruit and sweet intake; or for age, total energy intake, adherence to Mediterranean diet and physical activity (online Supplementary Tables S3 and S4). The goodness of fit was checked by the Hosmer and Lemeshow test, and it was found that all models have a good fit.

Finally, breakfast defined as the first eating episode at home was further analysed in food groups. There was no statistically

significant difference between maintainers and regainers in breakfast quality. No statistically significant difference was found between female maintainers and regainers in food groups consumed at breakfast meal. In men, however, those who regained weight had a higher intake of full-fat cheese at breakfast meal per day compared with those who maintained weight loss (0.5 (0–1.25) *v.* 0.0 (0.0–0.5) daily portions of full-fat cheese, respectively, $P = 0.007$) (one portion of full-fat cheese equals 30 g).

Discussion

The present study is the first one that examined various breakfast definitions in relation to weight-loss maintenance in participants who had maintained or regained weight loss. We observed that breakfast consumption was positively associated with weight-loss maintenance only in men. Breakfast definitions able to identify weight-loss maintenance were the first eating episode consumed at home or consumed at home excluding caffeinated drinks, as well as the self-reported breakfast definition.

It is of interest that breakfast consumption was positively associated with weight-loss maintenance only in men. This finding may be because of the fact that breakfast consumption is more common in women⁽⁶⁾. Thus, perhaps women consume breakfast independently of their maintenance status. Indeed, the percentage of male maintainers consuming breakfast regularly is twice the percentage of regainers, and this percentage is almost equivalent to the percentage of women.

Breakfast consumption was positively associated with weight-loss maintenance when breakfast was defined as the first eating episode at home or consumed at home excluding caffeinated drinks even after adjusting for potential confounders such as age, overall diet quality and total daily energy intake. A theoretical model supporting a role for breakfast in the development of obesity has been proposed⁽²⁾. According to this model, breakfast consumption may lead to reduced total energy intake and improved diet quality, and therefore a reduced obesity risk. This explanation is not in agreement with our data, as breakfast consumption was found to be associated with weight-loss maintenance independently of total daily energy intake and diet quality. We also observed that breakfast consumption was related to weight-loss maintenance even after adjusting for physical activity, according to the aforementioned breakfast definitions. These findings imply that breakfast consumption itself maybe protects against regaining.

Lately, regular consumption of breakfast has been associated with health outcomes, such as obesity⁽⁶⁾ or reduced incidence of diabetes⁽²⁹⁾ or CHD⁽³⁰⁾, independently of BMI, energy intake, physical activity and indicators of diet quality. It has been postulated that breakfast consumption may confer its health effects through ceasing prolonged fasting and thus by decreasing orexigenic stimuli (i.e. increased ghrelin levels in the fasting state) and by increasing anorexigenic stimuli (i.e. decreased insulin levels in the fasting state)^(6,29). In accordance with the previous hypothesis, our data denote that maintainers, having breakfast at home, stop prolonged fasting sooner compared with regainers. Therefore, it is possible that breaking prolonged fasting through breakfast consumed at home may result in an improved appetite-related hormone

status throughout the day and thus may lead to weight-loss maintenance. Further research is needed to elucidate potential mechanisms and pathways.

Breakfast quality may also affect long-term weight management, as a positive effect of whole-grain cereals and a negative effect of full-fat cheese on weight maintenance status were revealed in the present analysis. Data from the US National Weight Control Registry (NWCR) indicate that participants who manage to maintain weight loss usually consume cereals and fruits for breakfast⁽⁹⁾. Moreover, a recent clinical trial showed that participants consuming a high-carbohydrate breakfast showed better maintenance rates of weight loss⁽¹²⁾. Therefore, eating whole-grain cereals and avoiding full-fat cheese at breakfast meal possibly leads to maintaining weight loss.

Finally, based on what participants perceive as a breakfast meal, breakfast consumed 1–2 times/week or daily was positively associated with maintenance of weight loss. Daily consumption is a common characteristic among maintainers according to NWCR members, as 78% of registry members have reported this behaviour⁽⁹⁾. The present study is consistent with this finding: 56.2% of male maintainers compared with 36.8% of male regainers reported daily breakfast consumption. It should also be noted that statistical significance was lost after adjustment for total energy intake and adherence to Mediterranean diet. This could indicate that daily breakfast protects against regaining weight via reduced total energy intake. Indeed, breakfast consumption has been linked to total energy intake reduction^(31,32).

Strengths of the present study include the study sample that consisted of both maintainers and regainers. Furthermore, two 24-h dietary recalls were used in order to assess dietary intake, and breakfast consumption was assessed by twelve different definitions. It has, also, few limitations. The observational nature of the study indicates associations, but no causal inferences can be extracted from the present findings. All participant characteristics were self-reported; however, research indicates high concordance between objective and web-based self-reported measures of height and weight for adults⁽³³⁾. Finally, participants were not equally distributed in the two groups, with the maintainer group being three times bigger compared with the regainer group. However, we do not have an indication that this unequal distribution could have affected our results.

In summary, the present study indicates that when breakfast is consumed at home it may influence weight-loss maintenance. Further research should be conducted to clarify whether this finding applies only in males, as indicated by our results, as well as the potential mechanisms and pathways by which breakfast consumption confers its health outcomes. Public health strategies for the promotion of breakfast as the first at-home meal of the day may support primary and secondary obesity prevention. This was not a prospective study, and thus we cannot conclude that breakfast eating was a cause of success in weight-loss maintainers. Future studies, prospectively linking breakfast eating with success in weight maintenance, would help clarify this relationship.

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The authors declare that there are no conflicts of interest.

Supplementary material

For supplementary material/s referred to in this article, please visit <http://dx.doi.org/doi:10.1017/S0007114516001550>

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