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RESEARCH

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Eating Frequency Is Higher in Weight Loss Maintainers and Normal-Weight Individuals than in Overweight Individuals

JESSICA L. BACHMAN, PhD, RD; SUZANNE PHELAN, PhD; RENA R. WING, PhD; HOLLIE A. RAYNOR, PhD, RD

ABSTRACT

Eating frequency has been negatively related to body mass index (BMI). The relationship between eating frequency and weight loss maintenance is unknown. This secondary analysis examined eating frequency (self-reported meals and snacks consumed per day) in weight loss maintainers (WLM) who had reduced from overweight/obese to normal weight, normal weight (NW) individuals, and overweight (OW) individuals. Data collected July 2006 to March 2007 in Providence, RI, included three 24-hour dietary recalls (2 weekdays, 1 weekend day) analyzed using Nutrient Data System for Research software from 257 adults (WLM n=96, 83.3% women aged 50.0±11.8 years with BMI 22.1±1.7; NW n=80, 95.0% women aged 46.1±11.5 years with BMI 21.1±1.4; OW n=81, 53.1% women aged 51.4±9.0 years with BMI 34.2±4.1) with plausible intakes. Participant-defined meals and snacks were ≥50 kcal and separated by more than 1 hour. Self-reported physical activity was highest in WLM followed by NW, and then OW (3,097±2,572 kcal/week, 2,062±1,286 kcal/week, and 785±901 kcal/week, respectively; $P<0.001$). Number of daily snacks consumed was highest in NW, followed by WLM, and then OW (2.3±1.1 snacks/day, 1.9±1.1 snacks/day, and 1.5±1.3 snacks/day, respectively; $P<0.001$). No significant group differences were observed in mean number of meals consumed (2.7±0.4 meals/day). Eating frequency, particularly in regard to a pattern of three meals and two snacks per day, may be important in weight loss maintenance.

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J. L. Bachman is an assistant professor, Department of Nutrition and Dietetics, Marywood University, Scranton, PA. H. A. Raynor is an associate professor, Department of Nutrition, University of Tennessee, Knoxville. S. Phelan is an associate professor, Kinesiology Department, California Polytechnic State University, San Luis Obispo. R. Wing is a professor, Brown Medical School and the Miriam Hospital Weight Control and Diabetes Research Center, Providence, RI.

Address correspondence to: Jessica L. Bachman, PhD, RD, Marywood University Department of Nutrition and Dietetics, 2300 Adams Ave, Scranton, PA 18509-1598. E-mail: jbachman@marywood.edu

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The prevalence of overweight/obesity has reached epidemic levels in the United States, with >60% of adults being overweight (1). Although lifestyle interventions in successful in achieving weight loss, prevention of weight regain remains elusive (2). Therefore, it is important to identify factors that aid in successful weight loss maintenance.

Increasing the structure of the diet, in which procedures are put into place to help limit the amount and type of food consumed, appears to be important for successful weight loss maintenance (3). For example, a recent review of long-term lifestyle interventions to prevent weight regain after weight loss found that use of meal replacements, which control portion size and reduce variety in the diet, was related to weight loss maintenance (4). Research examining eating patterns of the National Weight Control Registry, a registry of more than 6,000 individuals who have lost and maintained a significant amount of weight loss (on average participants have lost 30 kg and kept it off for 5.5 years), has found that these individuals have a fairly structured diet: they regularly consume breakfast, have a consistent diet across weekdays and weekends, limit the variety of foods consumed, and report consuming close to five eating occasions per day (2,5,6).

Number of daily eating occasions—meals and snacks consumed per day—which is often reported as eating frequency, may be important in achieving a lower weight status (7,8). Eating more frequently may help to control hunger, which is believed to decrease the chance of overeating (9). Research investigating the relationship between eating frequency and weight has found mixed outcomes (10). Methodologic limitations in previous investigations, such as not examining the potential influence of physical activity (11) and including dietary underreporters in analyses (10), have been suggested as potential reasons for the unclear outcomes between eating frequency and weight.

The purpose of this study was to examine the relationship between eating frequency and weight loss maintenance. To achieve this purpose, comparisons between successful weight loss maintainers (WLM), normal weight (NW), and treatment-seeking overweight/obese (OW) individuals were made in the number of self-reported meals and snacks consumed per day. In addition, to account for poten-

tial confounding variables, physical activity was controlled for and under-reporters of dietary intake were excluded from this analysis. It was hypothesized that WLM and NW would have a greater eating frequency than OW.

METHODS

Participants

Participants for this secondary data analysis were part of two National Institutes of Health–funded investigations. Data for both investigations were collected between July 2006 and March 2007 in Providence, RI. The first was an 18-month randomized controlled trial examining the influence of a dietary variety prescription, which limited the variety of sweet and salty energy-dense foods consumed, on weight loss maintenance during a standard behavioral intervention. Baseline data from OW participants were obtained from this investigation. This trial was registered at ClinicalTrials.gov (NCT00328744). The second investigation was a cross-sectional study examining weight control behaviors of successful long-term WLM and NW controls. Data from WLM and NW were obtained from this study. Both studies were approved by the Institutional Review Board at the Miriam Hospital in Providence, RI. Written informed consent was obtained from all participants for the respective studies in which they were participants.

OW group participants were overweight and obese (body mass index [BMI] 27 to 45) individuals aged 21 to 65 years who could walk at least two blocks and regularly consumed at least five different sweet and salty energy-dense foods (assessed by a 1-week food record). Participants were ineligible if they reported major psychiatric diseases or organic brain syndromes, had a food allergy to commonly consumed foods, recently lost weight, took weight loss medication, were <6 months postpartum, currently breastfeeding, or planned to move out of the area during the time frame of the investigation. Baseline data from the randomized controlled trial were used in this investigation. Participants were not paid for baseline measures.

WLM and NW group participants were from the cross-sectional study in which participants were aged 18 years or older. WLM group participants were overweight/obese (BMI >25) at some point in their life, normal weight (BMI 19 to 24.9) at entry into the trial, had lost >10% of their maximum body weight and maintained that for at least 5 years, and were weight stable (±4.5 kg) within the previous 2 years. NW group participants were normal weight (BMI 19 to 24.9) at entry into the trial, never overweight or obese (BMI ≥25), and were weight stable (±4.5 kg) within the previous 2 years. Participants were located in all different parts of the United States, but predominantly participants were from New England (>70%), the same area as OW participants. Participants were paid $50 for assessments. Participants who had completed measures at approximately the same time period in which measures were collected from OW were included in this investigation.

Measures

For OW participants, all measures were collected at baseline, before randomization to the start of the intervention. For WLM and NW participants, all measures were administered at study enrollment. All variables, except for anthropometric measures, were measured identically in the two studies.

Self-reported information on age, sex, race/ethnicity, highest level of education, and marital status was collected from all participants. For OW, weight and height were measured and documented by trained and blinded assessors with an electronic digital scale (Healthometer Professional 597KL, Pelstar LLC, Bridgeview, IL) and a stadiometer (Seca 214, Seca North America, East Hanover, MD), respectively, according to standard procedures (12). Height and weight from WLM and NW was collected via self-report, which has been validated previously (13).

Self-reported physical activity was assessed using the Paffenbarger Activity Questionnaire (PAQ) (14) for all three groups. This questionnaire yields estimates of the total energy expended in physical activity per week. The PAQ has been shown to be significantly correlated with measures of cardiovascular fitness (15). Self-reported physical activity was used to help determine plausible dietary reporters and was included as a covariate in analyses to control for the effect of physical activity on eating frequency.

Dietary intake was assessed via three, random, nonconsecutive, 24-hour telephone dietary recalls (2 weekdays and 1 weekend day) for all three groups. Trained interviewers, blinded to group status, from the Cincinnati Center for Nutritional Research and Analysis at Children's Hospital Research Foundation of Cincinnati conducted interviews for both trials. Participants were given two-dimensional portion size estimation tools. Each 24-hour dietary recall was completed using the Nutrition Data System for Research software (version 2006, 2006, Nutrition Coordinating Center, University of Minnesota, Minneapolis).

The Goldberg cut-off equation (16) was used to identify under-reporters. The Goldberg equation assumes that energy intake equals energy expenditure, which can be calculated as basal metabolic rate×physical activity level, in weight stable individuals. Physical activity level, either 1.53 (inactive) or 1.76 (active), was coded for each participant based on energy expenditure from the PAQ (14) using guidelines from the joint report of the Food and Agriculture Organization/World Health Organization/United Nations University (17) and recommendations from the American College of Sports Medicine and the American Heart Association (18). A 99% confidence limit for reported energy intake:basal metabolic rate was calculated for each individual and those that were <99% confidence interval were classified as under-reporters (19).

Eating occasions were defined as any instance in which at least 50 kcal were consumed (food or drink). If two eating occasions were consumed within the same hour, they were combined and counted as one eating occasion. This method of calculating the number of eating occasions was based upon previous research (8). Meals and snacks were participant defined; however, only one eating occasion per day was counted as breakfast, lunch, or dinner, with the second reported same meal coded as a snack. Dietary recalls were reviewed twice by bachelor's degree– and master's degree–level nutrition-trained per-