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RESEARCH

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Associations between Snacking and Weight Loss and Nutrient Intake among Postmenopausal Overweight to Obese Women in a Dietary Weight-Loss Intervention

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ABSTRACT

Snacking may play a role in weight control. The associations of timing and frequency of snacking with observed weight change and nutrient intake were assessed in an ancillary study to a 12-month randomized controlled trial in Seattle, WA. Overweight-to-obese postmenopausal women (n=123) enrolled in the two dietary weight-loss arms from 2007 to 2008 with complete data at 12 months were included in these analyses. Generalized linear models were used to test the associations between snacking and weight loss (percent) and nutrient intake at the 12-month time point. Participants were, on average, 58 years old and mainly non-Hispanic white (84%). Ninety-seven percent reported one or more snacks per day. Weight loss (percent) was significantly lower among mid-morning (10:30 AM to 11:29 AM) snackers (7.0%, 95% confidence interval: 4.3 to 9.7) compared to non–mid-morning snackers (11.4%, 95% confidence interval: 10.2 to 12.6; $P=0.005$). A higher proportion of mid-morning snackers reported more than one snack per day (95.7%), compared to afternoon (82.8%) and evening (80.6%) snackers, although differences were not statistically significant ($P>0.05$). Women who reported two or more snacks per day vs one or no snacks per day had higher fiber intake ($P=0.027$). Afternoon snackers had higher fruit and vegetable intake compared to non–afternoon-snackers ($P=0.035$). These results suggest that snack meals can be a source for additional fruits, vegetables, and fiber-rich foods; however, snacking patterns might also reflect unhealthy eating habits and impede weight-loss progress. Future dietary weight-loss interventions should evaluate the effects of timing, frequency, and quality of snacks on weight loss.

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Meal pattern characteristics such as frequency, timing (eg, breakfast, late-night eating), or type (eg, main meals, snacks) may play a role in weight control. Positive associations have been observed between snacking frequency and energy intake (1-5), suggesting snacking could contribute to weight gain. However, the relationship of snacking with weight is inconclusive (4,6-10). In a recent review, 16 of 20 studies reported inverse associations between eating frequency and weight (11). However, if under-reporting of energy intake is not appropriately accounted for, snack intake may be underestimated (11-13). A review of controlled feeding studies concluded that snacks offered little to no benefit to overall regulation of food intake (14). Furthermore, a prospective analysis of National Health and Nutrition Examination Survey data detected no association of eating frequency with weight change (8). Conflicting findings may be a result of the lack of universal terms to define meals and

snacks (4,15) and may also vary by the setting and characteristics of the population studied (16).

The present study examined the relationships of between-meal snacking and snacking frequency with weight loss (percent) and nutrient intake using a simple, reproducible meal pattern grid to assess snacking patterns (4) among postmenopausal overweight-to-obese women in a year-long dietary weight-loss intervention. Little is known about snacking frequency and weight change in this population, a group at high risk for obesity and for chronic diseases from obesity, including diabetes, cardiovascular disease, and certain cancers such as breast, colon, and endometrium (17,18). It was hypothesized that snacking would be positively related to weight loss, fiber, fruit and vegetable intake, and inversely related to fat intake.

METHODS

Participants

Participants in this ancillary study were part of a larger, four-arm randomized controlled trial, testing the effects of nutrition and exercise-based interventions in breast cancer biomarkers and body composition (19). The four arms were diet-induced weight loss (Diet); aerobic exercise; both interventions combined (Diet+Exercise); and control. The design of the parent trial was detailed previously (19). Women enrolled in either the Diet or Diet+Exercise arms from June 2007 to August 2008 formed the Weight and Eating Behaviors cohort used for the current analyses. Women who completed the parent trial (n=92) prior to this ancillary study were not included in the Weight and Eating Behaviors cohort. The Fred Hutchinson Cancer Research Center Institutional Review Board approved all study procedures and study participants provided written informed consent.

Lifestyle-Based Interventions

A detailed description of the lifestyle-based interventions has been described elsewhere (19). Briefly, the goal of the exercise intervention was ≥45 minutes of moderate-to-vigorous intensity aerobic exercise, 5 days per week for 12 months. Participants attended three or more sessions per week at the study facility, supervised by an exercise physiologist, and exercised the remaining sessions at home.

The design and curriculum of the diet intervention were based on the Look AHEAD (Action for Health in Diabetes) and Diabetes Prevention Program studies (20,21), with the following goals: total intake of 1,200 to 2,000 kcal/day based on baseline weight, <30% calories from fat, and 10% reduction in weight by 6 months with maintenance to 12 months. Although separate instruction groups were held for women in the Diet and Diet+Exercise groups to reduce contamination; registered dietitians (RDs) with training in behavior modification delivered the same curriculum to both groups. The curriculum covered topics such as reducing fat and improving fiber intake, self-monitoring of weight and food intake, goal setting, and problem solving. Women were asked to maintain a daily food journal for 6 months or until they reached their weight-loss goal (10%). No specific recommendations were made concerning snacking behavior. Women met individually with an RD on at least two occasions, followed by weekly group meetings, for up to 6 months. Thereafter, women met with an RD at least semi-monthly (eg, one in-person, plus e-mail or phone contact), where self-monitoring of weight and food intake were still encouraged and sessions focused on staying motivated and dealing with barriers and lapses. However, those struggling with initial or maintenance of weight loss received additional RD assistance.

Demographic and Anthropometric Variables

Self-reported information on age, race/ethnicity, marital status, and education level were collected as baseline measures. Anthropometric measurements were collected at baseline and at 12 months and performed with the participant in a hospital gown. Trained technicians obtained height and weight using a balance beam scale (DETECTO, Web City, MO) and stadiometer (Perspective Enterprises, Portage, MI), rounding up to the nearest 0.1 cm and 0.5 kg, respectively.

Meal Pattern Grid

Meal pattern intake was measured at 12 months, using a self-administered, meal assessment grid used to describe typical frequency, types, and temporal distribution of meals. The instrument, developed by Berteus-Forslund and colleagues to assess meal patterns in obese and normal weight individuals in a Swedish population, demonstrated reasonable reliability (r=0.70) (4) and ability to distinguish meal patterns between lean and obese adults (2,4). This grid is currently being evaluated against 24-hour recalls in two collaborating work-site studies in the United States (S.A.A. Beresford, personal communication, April 15, 2011).

To complete the grid, the women indicated when they ate or drank during a typical 24-hour weekday, noting the time and type of meal (ie, main, light/breakfast, snack, beverage only). Participants were instructed to mark one box per line. If a respondent marked a meal and beverage box, the meal box was coded as the default. The grid provided examples of foods common to each meal type, but did not provide standard definitions. The only modification made to the original grid was to include foods familiar to an American audience (Figure 1).

Dietary Intake

Percent calories from fat, fiber (g/day), and fruit and vegetable intake (servings/day) were estimated at 12 months using the Women's Health Initiative food frequency questionnaire (22). The Women's Health Initiative food frequency questionnaire reasonably compares to food records and 24-hour recalls (mean intake based on 8 days worth of entries), with correlation coefficients for percent energy from fat of 0.62 and 0.70 for fiber (22). Women who reported values outside of the plausible range of energy intake (<600 kcal and >3,500 kcal) (22) were excluded from the main analysis (n=5).

Statistical Analyses

Distribution of main, light, and snack meals during the course of a typical 24-hour period was examined to establish the time periods for main meals (ie, breakfast, lunch,