RESEARCH
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Snacking Behaviors, Diet Quality, and Body Mass Index in a Community Sample of Working Adults

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ABSTRACT

Background Snacking behaviors have been linked with higher energy intake and excess weight. However, results have been inconsistent. In addition, few data are available on the extent to which snacking affects diet quality.

Objective This study describes snacking behaviors, including total snacking energy, frequency, time of day, and percentage of snacking energy intake by food groups, and their associations with diet quality and body mass index (BMI; calculated as kg/m^2).

Design Snacking behaviors and dietary intake were examined cross-sectionally among 233 adults participating in a community-based worksite nutrition intervention from September 2010 through February 2013. Three telephone-administered 24-hour dietary recalls were collected (2 weekdays; 1 weekend day). Diet quality was characterized by the Healthy Eating Index 2010 and BMI was computed using measured height and weight.

Setting The setting was a large metropolitan medical complex in Minneapolis, Minnesota.

Main outcome measures Outcome measures included diet quality and BMI.

Statistical analyses General linear regression models were used to examine associations between each of the snacking behaviors as independent variables, and diet quality and BMI as dependent variables.

Results Percent of snacking energy from fruit and juice (β=.13; P=0.001) and nuts (β=.16; P=0.008) were significantly positively associated with diet quality. Percent of snacking energy from desserts and sweets (β=−.16; P<0.001) and sugar-sweetened beverages (β=−.22; P=0.024) were significantly inversely associated. Percent of snacking energy from vegetables (β=−.18; P=0.044) was significantly associated with lower BMI. Percent snacking energy from desserts and sweets was significantly associated with a higher BMI (β=.04; P=0.017).

Conclusions Snack food choices, but not total energy from snacks, frequency, or time of day, were significantly associated with diet quality and BMI.

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SNACKING BEHAVIOR, OR EATING OCCASIONS THAT are outside of main meals, has increased in the United States over the past few decades and has been linked with higher energy intake and weight gain.[1-3] However, study findings have been inconsistent and the relationships among snacking, diet quality, and excess weight gain are still unclear.[2,4,5]

Particular aspects of snacking behavior have been hypothesized to be associated with both positive and negative outcomes regarding energy balance and body mass index (BMI; calculated as kg/m^2). For example, some have hypothesized that frequent snacking can promote more consistent feelings of satiety throughout the day and therefore lead to less overeating and improved daily energy balance.[6] Alternatively, frequent snacking throughout the day can contribute to excess energy intake unless less energy is consumed at meals.[7] Another hypothesis is that evening snacking might be more harmful to energy balance, perhaps because of excess calorie consumption or the choice of less healthful snack foods.[8]

Snack foods have typically been characterized as poor in nutritional quality, with most food items consisting of primarily fat and carbohydrates.[2,9] However, data on snack food choices and possible associations with diet quality in adults are limited.[5,9] Snacking in itself may not be harmful to a person's dietary quality and may increase the opportunity for the inclusion of healthy, low-energy food choices and a wider variety of foods in the diet.[4] In a recent study, five snacking patterns (ie, miscellaneous snacks, vegetables/legumes, crackers/salty snacks, other grains, and whole fruit) were associated with better diet-quality scores compared to participants with no reported snacking.[5]

This study aimed to examine patterns of snacking behavior (including frequency of snacking, snack energy intake, and

percent of snack energy from different foods) and examine the associations among snacking behaviors, diet quality, and BMI. It was hypothesized that greater energy intake from snacking and more frequent snacking would be associated with poorer diet quality and higher BMI. In addition, less-healthful snack food choices, such as chips, cakes, and sugar-sweetened beverages, were hypothesized to be associated with lower dietary quality and higher BMI.

METHODS

Subjects

Data are from baseline measures of 233 adults recruited to participate in a worksite nutrition intervention conducted at a major urban medical center from September 2010 through February 2013.[10] The study was approved by the University of Minnesota Institutional Review Board. Data were collected by trained research staff at a University research building located about a mile from the medical complex. Eligible participants were scheduled for an individual baseline data-collection visit, at which the study was reviewed, eligibility confirmed, and informed consent was obtained. Eligibility criteria included the following: age 18 to 60 years; nonsmoker; fluent in English; not taking medications that affect appetite or body weight; working at the medical complex full time, including during the lunch hours; not currently on a diet to lose weight; no history of a diagnosed eating disorder; not moving from the area during the next 6 months; not currently taking part in another research study; and not currently pregnant, nursing, or pregnant in the last 12 months.

The details of the intervention have been published previously.[10] The study purpose was to examine the effects of weekday exposure to one of three different lunch energy sizes on energy intake and body weight in a free-living sample of adults over 6 months. The study purpose was described as a feasibility study for the provision of box lunches to employees at the worksite. Efforts were made to recruit a diverse sample in terms of sex, income, education, and job type.

Dietary Measures

Dietary intake was measured using three telephone-administered 24-hour dietary recalls collected at baseline (a total of three recalls). Dietary recalls were conducted by trained and certified staff on nonconsecutive days (2 weekdays and 1 weekend day; all 3 days within a time window of 21 days maximum) over the telephone using Nutrition Data System for Research (NDSR) software (version 2013, Nutrition Coordinating Center, University of Minnesota). The Nutrition Coordinating Center interviewers were trained to probe in detail about portion sizes and to ask the participants to use portion-size examples to accurately report on the foods they ate. Food-group components and select dietary data were extracted from NDSR output to create both the diet quality and snacking behavior variables.

Diet Quality

The 2010 US Department of Agriculture Healthy Eating Index (HEI-2010)[11,12] was used to measure dietary quality based on mean values of food and nutrient intakes from an average of the three dietary recalls. The HEI quantifies diet quality in terms of the 2010 Dietary Guidelines for Americans.[11,13] The HEI-2010 consists of the sum of 12 components: 9 adequacy components and 3 moderation components, and ranges from 0 to 100, with a higher score indicative of a diet more consistent with the Dietary Guidelines for Americans. Food components examined included total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, and empty calories. Empty calories as defined by the HEI-2010 includes calories from solid fats, alcohol (beyond a threshold >13 g/1,000 kcal), and added sugars.[11,12]

Snacking Behaviors

Snacking behaviors were defined as meal entries designated as a "snack" using the NDSR interview system. Snack, within the NDSR data profile, represents any eating occurrence not designated by the participant as breakfast, brunch, lunch, dinner, beverage only, or other meal. The average frequency of snacking and the time of day for each snacking episode were determined for each participant based on the average of the three 24-hour recalls. Both average frequency of snacking and average total snacking energy were treated as continuous variables. Time of day was categorized into four time periods: morning (5:00 AM to 11:59 AM), early afternoon (12:00 PM to 2:59 PM), late afternoon (3:00 PM to 5:59 PM), and evening (6:00 PM to 5:00 AM) using the date and time of each snacking episode recorded in the NDSR data profiles.

Percent of snack energy intake from food groups was determined by calculating the amount of snacking energy from each food group and dividing each value by the total daily energy from snacking. Food groups were determined by aggregating 135 specific food-item groupings used by the NDSR system.

Body Weight and BMI

Body weight and height was collected during the initial baseline assessment. Participants were instructed not to eat any food or drink any caloric beverages for 3 hours before the appointment. Body weight was measured to the nearest 0.1 kg using a calibrated electronic scale (Befour Inc) with participants wearing light clothing and no shoes. Height was measured to the nearest 0.1 cm with a wall-mounted stadiometer. All measures were performed in duplicate. If the two measures differed by ≥1 cm or 0.5 kg, a third measurement was taken. The mean values of the two measures in closest agreement were used in analyses.

Covariates

Covariates included demographic information, objectively measured physical activity data, and total daily energy intake. Demographic information was self-reported and included age, sex, race and ethnicity, educational level, household income, job type, and marital status. Physical activity was measured using a commercially available ActiGraph GT1M accelerometer (ActiGraph) to determine the daily minutes of moderate-to-vigorous physical activity. Minimum wear time criterion was 4 days for a minimum of 9 hours per day.[14]