Snack Package Size and Variety Differentially Influence Energy Intake and Food Choices in Healthy Adults

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ABSTRACT

Background: While energy and nutritional content of snacks can contribute to overconsumption, other factors within the modern food environment may also influence the amount and types of snacks consumed.

Objectives: The aim was to examine whether snack package size and variety influence free-living snacking behavior in healthy adults. The impact of intuitive eating score on snacking behavior was also examined.

Methods: Thirty adults [age: 23.6 ± 0.8 y; BMI (kg/m^2): 22.8 ± 0.5] participated in a randomized crossover-design study. Participants were provided, in randomized order, with the following isocaloric snack exposures to consume for 3 d/exposure—*1*) CONTROL: highly appealing/appetizing snacks (e.g., dessert snacks, candy, savory snacks, fruits and vegetables, protein snacks); *2*) LARGE-PACKAGE: similar snacks as CONTROL but in larger package sizes; and *3*) VARIETY: larger variety of snacks. The primary outcomes included the 3-d average ad libitum snack energy, macronutrient content, and food choices for each snack exposure. The secondary outcome was the intuitive eating score and snacking behavior.

Results: LARGE-PACKAGE increased snack intake by 11.9% (1150 ± 81 kcal) compared with CONTROL (1030 ± 71 kcal, $P = 0.04$), whereas VARIETY snack intake (1030 ± 69 kcal) was no different from CONTROL ($P = 1.0$). LARGE-PACKAGE increased consumption of desserts compared with CONTROL ($P = 0.03$) and VARIETY ($P = 0.02$). Alternately, VARIETY increased consumption of fruits and vegetables compared with LARGE-PACKAGE ($P = 0.01$) and CONTROL ($P = 0.01$). Intuitive eating score was not significantly associated with snack intake or snack choice (all, $P > 0.05$).

Conclusions: Snack package size and variety differentially influence energy intake and food choices in healthy adults. This trial was registered atclinicaltrials.gov (NCT03940105). *Curr Dev Nutr* 2022;6:nzac004.

Keywords: snacks, diet quality, package size, snack variety, snack accessibility

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Introduction

Over the past few decades, snacking has become increasingly popular. To date, over 75% of Americans consume 2 or more snacks each day (1). These eating occasions, primarily occurring between lunch and dinner, are responsible for 23% of daily energy intake in US adults (2). Although different definitions of "snacking" exist in the literature (3), the current study considers snacking as any eating occasions outside of breakfast, lunch, and dinner. Further, snack foods and beverages (i.e., snacks) are defined as those items consumed during snacking.

Although some snacks can help in meeting dietary recommendations (e.g., fruits, vegetables, and dairy), many are prepackaged, ultra-processed items [e.g., candies, cakes, pastries, pies, dairy desserts, cookies, sugar-sweetened beverages (SSBs)] that contain high amounts of sugar and/or saturated fats (4). The 2020 Dietary Guidelines Advisory Committee Report illustrated that nearly 70% of added sugar intake comes from SSBs, desserts and sweet snacks, coffee and tea, candy and sugars, and breakfast cereals and bars (2, 4). Many of these foods are consumed within snacking occasions. In addition, approximately 20% of daily saturated fat intake comes from snack foods/beverages (2, 4). Since many energy-dense snacks are highly palatable, there is a propensity for overconsumption over the short term (5). While snack palatability and energy content can influence intake, other factors within the modern food environment may also influence the amount and types of snacks consumed.

The accessibility, amount, and variety of foods and beverages are factors generally thought to influence consumption. A common example combining these factors includes restaurant buffets and the (theoretical) overconsumption that occurs. Although there are no published studies that directly compare buffet-style with single-entrée–style eating occasions, many studies, including those from our laboratory (6–8), include this type of experimental design and report intakes much higher than what is habitually consumed. In a laboratory setting, simply placing a snack further away from one's immediate grasp decreased the amount of snacks that were eaten (9). Alternatively, in a study that simulated a grocery store, increasing the accessibility of healthy snacks through more shelf space resulted in a greater likelihood of purchasing the healthy snacks (10). Additionally, increasing the package size of snacks and/or increasing the variety of snacks also increased subsequent intake in some (11–14) but not all (15, 16) studies. However, most of the studies that found an increase in intake utilized laboratory-based, single-day experimental designs and did not examine energy and food choices throughout multiple days in a free-living environment (12–14).

Thus, we sought to extend the current evidence to examine whether snack package size and variety influence snacking behavior in healthy adults in a free-living environment over the course of multiple days. We hypothesized that larger package size and greater variety would result in increases in overall snack energy intake as well as increases in consumption from all snack categories. The primary outcomes included the 3-d average ad libitum snack energy content and food choices for each snack exposure.

Last, "intuitive eating" is a term used to describe the level of mindfulness in our decision to "eat" and what food choices to make (17). Intuitive eating score, which is a measure of an individual's tendency to rely on internal hunger cues rather than external cues (e.g., package size, variety) to determine eating behavior, is inversely associated with BMI and positively associated with better diet quality (18–20). Although mindfulness training is not shown to be effective in reducing portion size in either snacks (21) or meals (22) at a single eating occasion, little is known whether intuitive eating influences daily intake or food choices. Therefore, the relation between baseline intuitive eating score and energy intake and food choices in the present study was also examined. The secondary outcome included the intuitive eating score and snacking behavior. It was hypothesized that intuitive eating score would be inversely associated with snack energy intake as well as energy coming from energy-dense dessert snacks and positively associated with fruit and vegetable snack energy intake.

Methods

Study participants

From October 2018 to February 2019, healthy adults were recruited from the greater Lafayette, Indiana, area through flyers and word-of-mouth to participate in the study. Eligibility was determined through the following inclusion criteria: *1*) age range of 18–55 y; *2*) normal to obese [BMI (kg/m^2): 18–32]; *3*) healthy, nondiabetic; *4*) not currently or previously following a weight-loss or other special diet (in the past 6 mo); *5*) nonsmoking (for the past 6 mo); *6*) not been clinically diagnosed with an eating disorder; and *7*) habitually snacks (i.e., at least 4 times/wk) between lunch and dinner.

Thirty-eight adults were initially interested in participating in the study; 31 met the screening criteria and completed all study procedures. Last, 1 participant had snack intake data that were extreme outliers (i.e., values >3 times the IQR above the third quartile) and was thus excluded from analysis (**Figure 1**). The participants (2 men, 28 women) were healthy, normal-to-obese young adults (age: 23.6 ± 0.8 y; BMI: 22.8 ± 0.5). None of the female participants were pregnant, lactating, or postmenopausal. All participants were informed of the purpose and risks of the study. The study was approved by the Purdue Institutional Review Board (IRB), and all participants signed the IRB-approved study informed consent, which included, but was not limited to, authorizing use and inclusion of de-identified data in published research. In addition, all procedures were followed in accordance with the ethical standards of the IRB. The participants received a total of $100 ($25/treatment) for completing all study procedures. The study is registered at clinicaltrials.gov (NCT03940105).

Experimental design

The participants completed the following randomized, single-blind, crossover-design study. Participants were provided, in randomly assigned order, with the following isocaloric snack exposures to consume for 3, nonconsecutive weekdays/exposure—*1*) CONTROL: commonly consumed snacks (e.g., dessert snacks, candy, savory snacks, fruits and vegetables, protein snacks); *2*) LARGE-PACKAGE: similar snacks in larger package sizes; and *3*) VARIETY: larger variety of snacks within the above CONTROL food categories. Standardized breakfast, lunch, and dinner meals were provided throughout the assessment days. There was a 2- to 7-d washout period between each snack exposure. Participants were instructed to retain habitual levels of physical activity throughout the course of the study.

Snack exposures

Participants completed 3 snack exposures. Each exposure consisted of 3 weekdays, separated by 1 to 3 d. Thus, depending on participant availability, the 3-d exposures occurred on Monday/Wednesday/Friday or Tuesday/Thursday/(following) Monday. However, the same day of week pattern was used for each exposure within a participant. Snacks were provided in coolers packed out to the participants. The participants were allowed to eat the snacks ad libitum in a free-living environment. The coolers consisted of a variety of commonly consumed, highly appealing, highly appetizing snack foods (4) and contained approximately 5500 kcal/d to ensure that participants could consume as much as they desired without running out of snacks. Depending on the respective snack exposure, the coolers differed in package size or variety (see **Table 1**). The participants were given 1 cooler/d and had 3 d/exposure. From 30 min after lunch until dinner and 30 min after dinner until going to bed, participants were permitted to snack as much or as little as they desired from foods included within the coolers. Participants were provided ice packs in the coolers in order to keep certain foods cold (i.e., fruits and vegetables, ice creams). This enabled the participants to bring the cooler with them wherever they went throughout the day. All contents were weighed before the coolers were sent home and any wrappers, partially consumed foods, etc., were re-weighed upon return to determine energy and macronutrient content as well as snack type and quantity of foods consumed. Participants were allowed to consume any beverages they desired but were asked to keep a record of all beverages consumed and return any beverage containers (when possible) when the cooler was brought back.

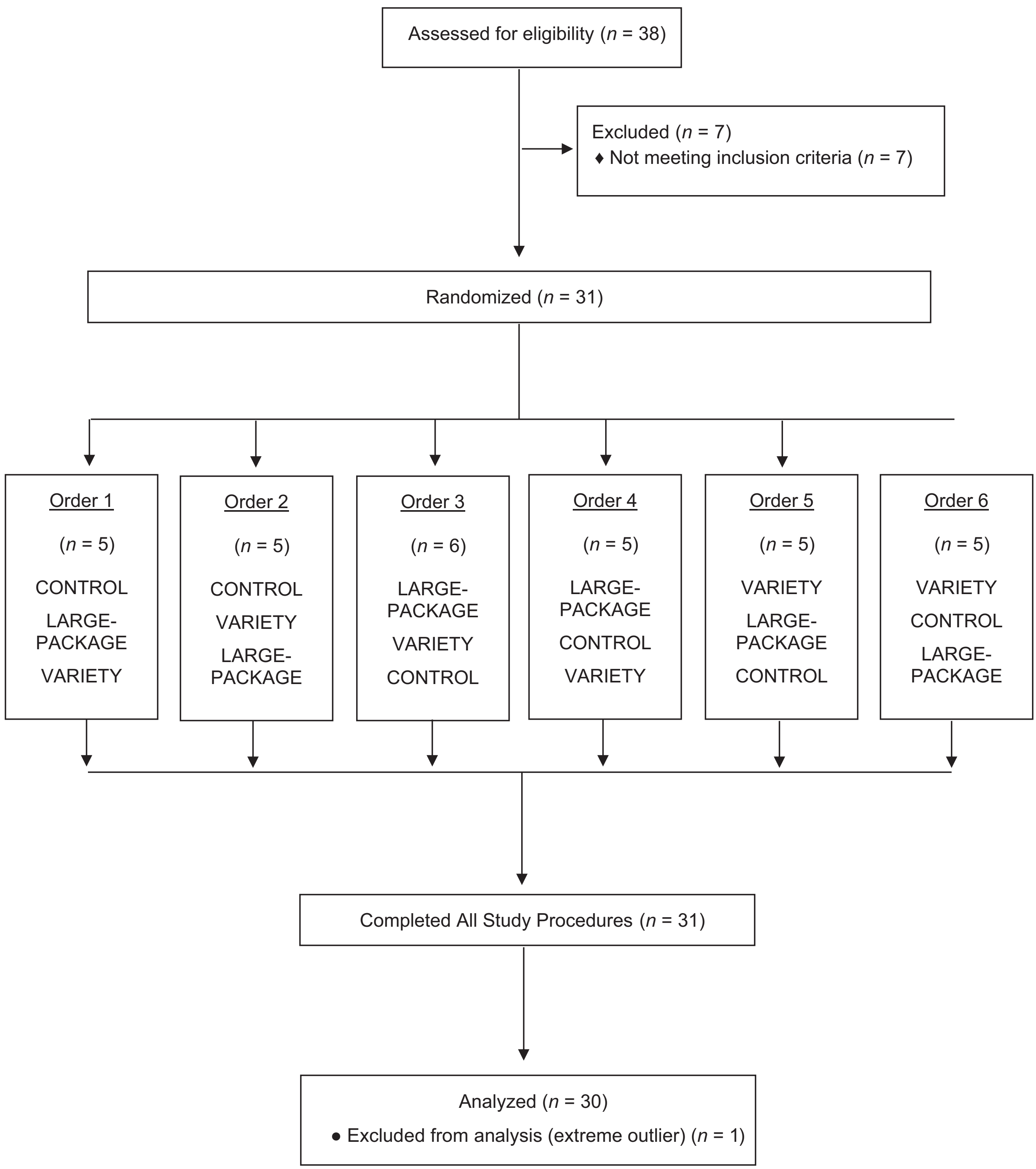

FIGURE 1 CONSORT diagram. CONSORT, Consolidated Standards of Reporting Trials.

Prior to the start of the snack exposures, palatability of each snack food provided within the coolers was completed (see Table 1). Palatability was assessed using a 100-mm visual analog scale asking, "Overall, how much do you like this snack," with line anchors ranging from "extremely dislike" (i.e., 0 mm) to "extremely like" (i.e., 100 mm). A middle anchor at 50 mm depicted "neither like nor dislike." The snacks in the CONTROL and LARGE-PACKAGE pack-out had a meanpalatability score of 72.8 ± 1.9, whereas the snacks in the VARIETY pack-out had an average palatability score of 72.6 ± 1.7. This indicates the snacks chosen for the pack-outs were highly appealing and highly appetizing. Every participant indicated that they "liked" (score >50 mm) at least half of the study snacks provided.

TABLE 1 Snack exposure characteristics

Foods provided	CONTROL	LARGE-PACKAGE	VARIETY	Palatability on visual analog scale[1]
Dessert snacks				
Brownie bites	3 (3 brownie) containers	1 (9 brownie) container	1 (3 brownie) containers	82 ± 3
Cookie dough ice cream	4 (4 oz) cups	1 pint	2 (4 oz) cups	84 ± 4
Fudge brownie ice cream	—	—	2 (4 oz) cups	82 ± 4
Fruit snacks	—	—	2 (0.9 oz) packs	72 ± 4
Sandwich cookies	—	—	2 (1 oz) bags	73 ± 5
Candy				
Sweet n' sour candy bites	4 (0.65 oz) packs	1 share size (2.17 oz)	2 (0.65 oz) packs	53 ± 6
Peanut butter cups	4 (0.75 oz) items	1 (2.8 oz) bag	2 (0.75 oz) items	77 ± 4
Milk chocolate bites	—	—	2 (0.50 oz) bags	74 ± 5
Savory snacks				
Potato chips	3 (1 oz) packs	1 (2.75 oz) pack	2 (1 oz) packs	62 ± 5
Pretzel crisps	3 (1 oz) packs	1 (3 oz) pack	2 (1 oz) packs	75 ± 4
Nacho cheese tortilla chips	—	—	2 (1 oz) packs	63 ± 5
Fruits and vegetables				
Gala apples	2 small apples	1 large apple	2 small apples	79 ± 4
Baby carrots	4 (3 oz) packs	1 (12 oz) pack	4 (3 oz) packs	77 ± 3
Red pepper hummus	4 (2 oz) cups	1 (10 oz) cup	2 (2 oz) cups	73 ± 5
Guacamole	—	—	2 (2 oz) cups	74 ± 5
Mandarin orange cups	—	—	2 (4 oz) cups	70 ± 5
Protein snacks				
Roasted almonds	4 (1.5 oz) bags	1 (6 oz) container	2 (1.5 oz) bags	79 ± 3
Beef jerky	4 (0.62 oz) bags	1 (2.85 oz) bag	4 (0.62 oz) bags	60 ± 6
Roasted peanuts	—	—	2 (1.5 oz) bags	72 ± 5

[1]Values are means ± SEMs, $n = 30$.

Standardized meals

In an attempt to control for meal energy and meal food choices prior to the afternoon/evening snacking assessments, the participants were provided with specific breakfast, lunch, and dinner meals to consume during the snack exposure days. In order to promote a more naturalistic study environment, participants were allowed to decide when they consumed each meal. Breakfast was 390 kcal (17% of energy as protein, 60% of energy as carbohydrate, and 22% of energy as fat) and included quesadillas and pineapple cups. Lunch was 500 kcal (16% of energy as protein, 52% of energy as carbohydrate, and 33% of energy as fat) and included a turkey and cheese sandwich, chips, and applesauce. Dinner was 270 kcal (25% of energy as protein, 54% of energy as carbohydrate, 18% of energy as fat) and included a self-selected frozen entrée. The reduced energy provided as the dinner meal was chosen to encourage the continuation of snacking throughout the evening. All contents within each meal were weighed before consumption and any wrappers, partially consumed foods, etc., were re-weighed upon return to determine energy and macronutrient content of foods consumed.

Intuitive eating score

During baseline, participants completed the Intuitive Eating Scale-2 (20). This 23-item survey includes statements such as "I try to avoid certain foods high in fat, carbohydrates, or calories" and "I have forbidden foods that I don't allow myself to eat," with anchors of "1, strongly disagree" to "5, strongly agree." Total Intuitive Eating Scale-2 scores and subscale scores (i.e., unconditional permission to eat, eating for physical rather than emotional reasons, reliance on hunger and satiety cues, and body–food choice congruence) were then calculated, with higher values indicating greater intuitive eating.

Statistical analyses

The difference in energy intake between treatments from a previously conducted snack study indicated that a sample size of $n = 9$ would provide 80% power to detect differences in energy intake in the current study (23). An initial dropout rate was set at 25% to establish the study sample size of $n = 40$. Thus, the final sample size of $n = 30$ was more than adequate to detect differences in study outcomes.

Summary statistics (sample means and sample SDs) were computed for all data. The 3-d average was determined for snack energy content, macronutrient content, and the amount of snack energy consumed within the following food categories during each snack exposure: dessert snacks, candy, savory snacks (chips and pretzels), fruits and vegetables, protein snacks (meat and nuts), and beverages. A snack was considered any food or beverage that was not provided at the breakfast, lunch, or dinner meals.

To examine whether snack package size or variety influenced snacking behavior, repeated-measures ANOVAs examining the main effects of snack exposure (i.e., CONTROL, LARGE-PACKAGE, VARIETY) were performed on all study outcomes. Treatment order was included as a between-subjects independent variable to assess whether any carryover effects occurred. When main effects were detected, post hoc pairwise comparisons were performed using Bonferroni correction to adjust

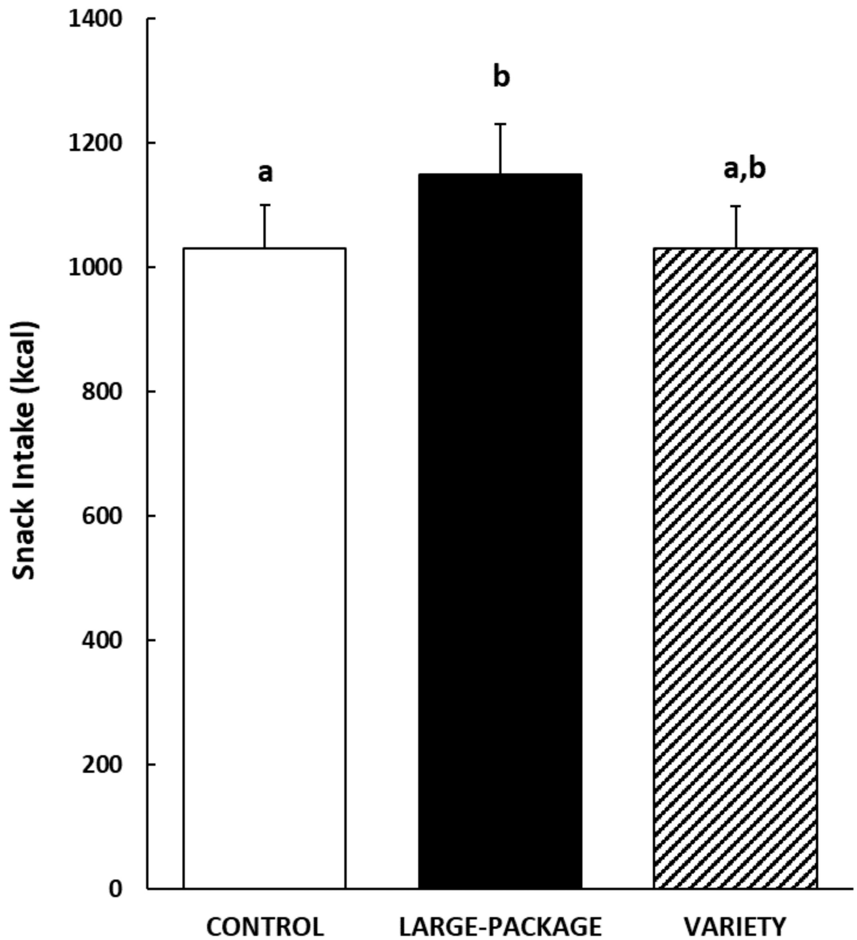

FIGURE 2 Energy consumed as afternoon/evening snacks following each of the 3-d assessments in healthy adults. Values are means ± SEMs, $n = 30$. Different lower-case letters denote significance between snack exposures; post hoc pairwise comparisons with Bonferroni correction, $P \leq 0.05$.

for multiple comparisons. In identifying potential outliers in any of the measurements, 1 participant had pack-out consumption that was 3 SDs greater than the group average. Upon removal, all data met sphericity and normality assumptions of the repeated-measures ANOVA. Additionally, Pearson correlation analyses were performed on snacking behavior and intuitive eating scores.

Values in the text are means ± SEMs. Analyses were conducted using the Statistical Package for the Social Sciences (version 21.0; IBM SPSS Statistics). $P \leq 0.05$ was considered statistically significant.

Results

Average energy intake from afternoon/evening snacking during each of the 3-d exposures is shown in **Figure 2**. LARGE-PACKAGE increased overall snack intake by 11.9% compared with CONTROL ($P = 0.04$) but had no effect on overall snack intake compared with VARIETY ($P = 0.15$; Figure 2). VARIETY snack intake was not different from CONTROL ($P = 1.00$; Figure 2). LARGE-PACKAGE increased consumption of dietary protein, fat, and carbohydrates compared with VARIETY (all, $P < 0.05$) and increased carbohydrate consumption compared with CONTROL ($P = 0.05$; **Table 2**). LARGE-PACKAGE also tended to increase sugar consumption compared with CONTROL ($P = 0.085$; Table 2). VARIETY reduced consumption of carbohydrates compared with CONTROL ($P = 0.02$) but had no other effects on macronutrients compared with CONTROL (all, $P > 0.05$; Table 2). No other differences occurred between snack exposures and macronutrient intake (all, $P > 0.05$; Table 2). There were no effects of treatment order on snacking energy or macronutrient intake (all, $P > 0.05$).

LARGE-PACKAGE increased consumption of desserts compared with CONTROL ($P = 0.03$) and VARIETY ($P = 0.02$), whereas there was no difference in dessert intake between CONTROL and VARIETY ($P = 0.30$; Table 2). VARIETY increased consumption of fruits and vegetables compared with LARGE-PACKAGE ($P = 0.01$) and compared with CONTROL ($P = 0.01$), whereas there was no difference in fruit and vegetable intake between CONTROL and LARGE-PACKAGE ($P = 0.96$; Table 2). No other significant differences occurred between snack exposures and snack choices (i.e., candy, savory snacks, protein snacks, and beverages; all, $P > 0.05$; Table 2). There

TABLE 2 Snack nutrients and energy consumed within specific snack categories within each 3-d assessment[1]

	CONTROL	LARGE-PACKAGE	VARIETY
Snack macronutrients, g			
Protein	21.3 ± 1.9[a,b]	24.5 ± 2.1[b]	19.9 ± 1.6[a]
Fat	53.2 ± 4.0[a,b]	60.0 ± 4.5[b]	47.2 ± 3.6[a]
Carbohydrates	123 ± 9.0[b]	136 ± 11[c]	98.5 ± 7.2[a]
Fiber	9.8 ± 0.9[a]	10.2 ± 0.8[a]	10.1 ± 0.8[a]
Sugar	69.2 ± 6.0[a,2]	77.3 ± 7.3[a]	67.9 ± 5.6[a]
Snack categories, kcal			
Desserts	526 ± 53[a]	631 ± 73[b]	477 ± 44[a]
Candy	97.8 ± 24[a]	78.9 ± 20[a]	91.9 ± 20[a]
Savory	120 ± 13[a]	140 ± 18[a]	142 ± 15[a]
Fruits and vegetables	129 ± 18[a]	112 ± 21[a]	167 ± 20[b]
Protein foods	153 ± 33[a]	188 ± 32[a]	147 ± 23[a]
Beverages	80.9 ± 20[a]	83.8 ± 21[a]	73.6 ± 17[a]

[1]Values are means ± SEMs, $n = 30$. Different superscript letters denote significance between snack exposures; post hoc pairwise comparisons with Bonferroni correction, $P \leq 0.05$.
[2]CONTROL vs. LARGE-PACKAGE; post hoc pairwise comparisons with Bonferroni correction, trend ($P = 0.085$).

were no significant effects of treatment order on snack choices (all, $P > 0.05$).

Intuitive eating score

The overall average intuitive eating score was 3.7 ± 0.1 (out of 5) and ranged from 2.6 to 4.9. Participants had the following average scores (out of 5) for the following subscales: unconditional permission to eat, 3.9 ± 0.1; eating for physical rather than emotional reasons, 3.6 ± 0.1; reliance on hunger and satiety cues, 3.8 ± 0.2; and body–food congruence, 3.7 ± 0.1.

Pearson correlation analyses identified no significant associations between intuitive eating score and snack habits (all, $P > 0.05$).

Discussion

Snack foods of larger package sizes led to greater energy consumed as snacks and greater consumption of unhealthy "dessert" snacks, which are high in dietary fat and added sugars. However, increasing the variety of snacks provided did not increase unhealthy snacking but actually increased consumption of fruits and vegetables. Collectively, these data suggest that external factors related to the modern snack-food environment impact snacking behaviors in healthy adults.

Snack manufacturers have developed a wide assortment of snack package sizes over the last few decades. Grocery stores now sell snacks in all sorts of sizes and amounts, from 100-calorie packs to family- and party-size bags. Package sizes of all sorts of foods started to increase in the 1970s, rose sharply in the 1980s, and have continued to steadily grow in the last few decades (24). Over the same time period, the variety of snack options in the marketplace has also dramatically increased. Over 10 times the number of new snack products were introduced to the marketplace in 1996 when compared with 1970 (25). Specifically, the number of new energy-dense and nutrient-poor snack products (e.g., desserts and candy) has increased disproportionately to the number of new fruit and vegetable products (25). The increase in packaging size and increased variety of available snacks have occurred concomitantly with the rise in obesity. Yet, it is unclear as to the role these factors play in unhealthy weight gain and obesity.

Only a few published studies exist that examined the effect of snack package size on subsequent energy intake over the course of multiple days in healthy adults (11, 15). As shown in Stroebele et al. (11), participants consumed an average of 187 g of fewer snacks per week when the snacks were provided as 100-kcal snack packs compared with standard-size snack packs ($P < 0.0001$). According to a study by Raynor and Wing (15), no difference in snack energy intake was observed between groups based on package size (small package vs. large package: 4027 ± 873 kcal/3 d vs. 3783 ± 881 kcal/3 d; nonsignificant). The findings from the later study are contrary to the current study findings, which showed greater intake with LARGE-PACKAGE vs. CONTROL sizes. One reason for this difference may be that, in the Raynor and Wing study, only 4 different snacks were offered to the participants, whereas in this study 11 different small- or large-package snacks were offered to the participants. It is possible that an increase in snack options might make any potential package size effect more apparent. In addition, it is possible that the Raynor and Wing study was underpowered to detect a difference between snack treatments given the between-subject design that was utilized in that study compared with our within-subject crossover design.

There are several plausible reasons as to why larger package sizes might increase food intake. One is the idea of unit bias. Geier et al. (26) defined unit bias as "a sense that a single entity (within a reasonable range of sizes) is the appropriate amount to engage, consume, or consider." For example, if an individual is consuming a bag of potato chips, they may assume that 1 chip bag (regardless of how large, but also within reason) is the appropriate amount of chips for them to consume. In the present study, the larger packages of snacks were large enough to contain multiple servings, but not too large to prevent the participant from consuming an entire package (see Table 1). Package size prompts individuals to deliberate and decide whether or not they should continue to consume that specific food (27). When consumers stop and consider further snack consumption, they are forced to take into account potential negative consequences such as weight gain or being viewed as impulsive by others (27, 28). The consumption of more units of food is considered to be more impulsive than the consumption of fewer units of food, even if the food with more units is much smaller in size (28). Therefore, individuals often curtail consumption when eating from smaller units of food, especially when in the presence of others. One last explanation as to why larger units of food might increase intake more than smaller units of food is that individuals are usually in a "zone of biological indifference." In other words, when a person is neither genuinely hungry nor genuinely satiated (29), they may simply rely on food characteristics such as package size to know when to stop eating (23). However, food characteristics are often misleading, and excess energy intake might occur. In the present study, participants were provided small breakfast, lunch, and dinner meals. Although no appetite or satiety data were collected, the small meals most likely encouraged snack consumption.

In addition to snack package size, snack variety was also assessed. Although we hypothesized that the increase in snack variety would result in an increase in energy intake compared with intake from the CONTROL pack-out, this did not occur. In other studies that examine energy intake and variety, consumption when 1 food item is offered is often compared with consumption when 3 food items are offered (13, 14, 30). Generally, these studies found that 3 food items led to greater food intake at a single eating occasion compared with 1 food item, although there are slight differences in results that occur based on factors such as body weight (30), social setting (13), and the sensory property of the food that was altered (14). In the current study, the CONTROL exposure contained 11 snack options, whereas the VARIETY exposure contained 19 snack options. The variety of snack options was almost doubled in the VARIETY exposure, but snack energy intake remained about the same. However, it is important to note that increasing the number of snack options resulted in an increase in fruit and vegetable consumption, indicating potential health benefits from variety. This increase in fruit and vegetable consumption is likely not a result of increased liking of the added fruits and vegetables, as the added fruits and vegetables had a similar palatability to the fruits and vegetables in the CONTROL exposure (Table 1). The reason overall snack intake remained the same might be that both exposures had plenty of snack options, thus limiting sensory-specific satiety (31), even in the CONTROL exposure. The findings from the VARIETY exposure suggest a potential "snack variety ceiling effect." In essence, as snack variety initially increases, snack intake is also likely to increase significantly. However, as snack variety continues to increase, its effect diminishes until it reaches a plateau or ceiling. Past this point, regardless of how much you increase snack variety, snack intake will no longer increase. A similar effect is found in portion sizes. An initial doubling of portion size increases intake by 35%, but a "portion size ceiling" appears to occur as portion size nears 800 g (32). As snack variety or portion size continues to increase, individuals are thought to rely more on intuitive eating characteristics such as internal cues to guide eating behavior.

The secondary objective within this study was to examine the association between intuitive eating score and snack intake. The basis behind intuitive eating is the idea that the body "knows" how much food and what types of food it needs in order to function properly and maintain a healthy weight (19). However, environmental factors such as large package sizes and variety make it difficult to listen to ingestive behavior cues. Individuals who rely on intuitive eating may find it easier to block out external distractions and thus be less influenced by environmental and/or social factors. In fact, training in mindful eating, a concept very similar to intuitive eating, has been shown to improve eating behaviors in response to external cues in both women with overweight/obesity and women with disordered eating (33, 34). Additionally, mindful eating training is shown to improve aspects of dietary intake, including reducing daily caloric and fat intake (35). A recent study in women with overweight and obesity found that 12 wk of an intuitive eating intervention resulted in significant improvements in self-esteem, life satisfaction, fruit and vegetable consumption, and BMI at a 12-mo follow-up (36). Few other studies have examined intuitive eating training and its effect on eating behaviors. In the current study, no significant associations were found between intuitive eating score and snack habits. Further research is needed to determine the exact effect of intuitive eating on snacking and eating behaviors.

Limitations

A number of limitations exist with this study. This study had a disproportionate number of female participants compared with male participants. Therefore, it was impossible to determine whether a gender effect existed. Future studies are needed in order to examine whether package size and food variety influence males and females in different ways. Additionally, food security was not considered in this study. Despite that this study took place in an affluent area (i.e., West Lafayette, IN), it is possible that some of the participants were food insecure, thus potentially impacting the results. It should also be noted that, while this study was longer than past studies that have examined package size or variety, it was still an acute trial. Also, snack exposure days occurred only on weekdays, so future studies should examine whether different results would occur on weekends. The snack exposures provided were likely novel to the participants; however, each snack exposure included commonly consumed snack foods and 3 d of assessment. Even if the exposure study design was new to the participants, the snacks likely were not. The potential problems associated with food security or pack-out novelty are also attenuated by the fact that this was a within-subject comparison study. Additionally, this study provided breakfast, lunch, and dinner to the participants, and these meals contributed approximately 1200 kcal to total energy intake. This is less than the average energy content normally provided by meals for American adults [according to NHANES data, meals provide ∼1950 kcal for males and 1400 kcal for females (37, 38)]. The current study did not assess habitual energy intake at meals for participants. However, the Raynor and Wing study (15) mentioned previously did not provide any meals to their participants (i.e., participants were allowed to consume whatever meals they wanted), yet snack intake was still higher in their study compared with the current study (small-package group average was 1342 kcal/d and large-package group average was 1261 kcal/d, both of which are higher than any 3 of the snack exposures). This indicates that, regardless of meal condition, participants are likely to overconsume highly appealing, highly appetizing snacks when they are easily accessible. Last, this study did not examine additive effects (i.e., LARGE-PACKAGE with VARIETY). Future studies are needed to determine whether increases in package size and variety result in even greater increases in intake.

Conclusions

In conclusion, larger packages of snacks led to significantly greater intake compared with smaller packages of snacks, whereas snack variety did not. Greater snack variety, however, did result in greater intake of fruits and vegetables. Further research is needed to determine whether larger packages or greater variety of snacks result in greater intake in the long-term.

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