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Benefits of a snacking intervention as part of a school-based obesity intervention for Mexican American children

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Introduction

On average, American children consume between two and three snacks a day, which account for more than a quarter of their daily energy intake.[1] Children's snacks often consist of foods high in sugar, fat, and sodium.[1] Snacking or eating outside the standard three daily meals (breakfast, lunch, and dinner)[2,3] is frequently implicated as a cause of excessive energy intake and a contributor to an unhealthy weight status.[4] However, observational studies and randomized controlled trials have been unable to establish a consistent association between snacking and weight gain or obesity.[4,5]

Some studies, such as the Bogalusa Heart Study, report a positive association between snacking and overweight status in children,[2,3,6-11] whereas other studies have demonstrated an inverse association[12-16] or no relationship at all.[17-25] The interaction of snacking with another lifestyle factor, such as watching television[26,27] or having at least one overweight parent,[27] has been proposed as a possible explanation for the inverse association found between snacking and obesity.[28] Similarly, regular and consistent snacking daily and at a predicable time of day (eg, an afternoon snack) has been shown to promote satiety and decrease energy intake at the following meal.[29] Overall, there appear to be healthy snacking behaviors, which promote energy regulation and a healthy weight status, and unhealthy snacking behaviors, which involve the consumption of energy-dense and nutrient-poor snacks that are associated with other lifestyle variables and result in excess weight gain or obesity.[28,30]

Irregular eating habits or snacking patterns become more common during adolescence.[31] This is concerning because children who engage in irregular eating or snacking are at increased risk for being overweight.[31] Successful weight management involves a multi-component approach comprising behavior modification, nutrition education, and physical activity.[32] However, these interventions may not directly address irregular snacking patterns. As a result, there is a need for interventions that directly address irregular eating habits in adolescents, including the possible weight benefits of peanut snacking in children.

Nuts are high in fat, and concerns have been raised that encouraging an increased intake of nuts will lead to weight gain. However, the majority of studies in adults have not reported weight gain when nuts are consumed.[33] In fact, peanut consumption was often associated with a lower body mass index (BMI).[34] Peanuts and peanut butter are well accepted by children, and further research to evaluate these foods as possible healthy snack interventions is warranted. Although peanuts and

especially peanut butter are popular in the United States, parents have been concerned regarding the exposure of children to peanuts in schools. However, in 2010, a random telephone survey of 5300 households (13,434 subjects) in the United States estimated that the prevalence of peanut, tree nut, and sesame allergies was relatively low.[35] Findings indicated that the prevalence of peanut allergy in children was 1.4% in 2008, compared with 0.8% in 2002 and 0.4% in 1997.[35]

The purpose of this study was to investigate the feasibility of including a peanut snacking component as part of an intensive obesity intervention for overweight and obese Mexican American adolescents in Houston, where 52% of the children are Latinos.[36] Hispanics are disproportionately at greater risk for acquiring conditions associated with obesity.[37] Snacking behavior is also prevalent in Mexican children.[38] This study was a secondary analysis of the Family Lifestyle Overweight (FLOW) Prevention Program,[39] which was a school-based pediatric intervention for urban, low-income, minority students that included nutrition and physical activity education and a snacking intervention. Students were provided a daily afternoon snack of peanuts or peanut butter intended to normalize eating habits with a consistent afternoon snack.[39] We hypothesized that children who adhered to the snacking component of the intervention would demonstrate a greater decrease in standardized BMI (zBMI) at 6 months compared with children who did not comply with the snacking intervention.

Methods

Participants

This study was a secondary analysis of children (n = 1103) enrolled in a longitudinal study in which they were randomized to either an intensive school-based obesity intervention program (n = 593) or a typical physical education class offered by the school (n = 510). The study included a series of child cohorts derived from three charter schools in Houston, Texas, from 2005 to 2012. Approximately 95% of the charter schools' population was Mexican American. Only children with complete data who were of unhealthy weight (ie, overweight or obese), were randomly assigned to the instructor-led intervention (n = 257), completed the 6-month intervention, and were not lost to follow-up were included in the secondary analysis (Figure 1). The instructor-led intervention consisted of a daily 12-week intensive behavioral intervention that included nutrition instruction, physical activity training, and a snacking intervention designed to address irregular eating patterns by providing a consistent afternoon

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snack; the intensive behavioral intervention was followed by a 12-week maintenance intervention. This intervention has been described in detail previously.[39] All students assented to participation and returned parental consent forms and demographic surveys. The institutional review board of Baylor College of Medicine and Texas Woman's University approved the study.

Self-reported demographic information, such as gender and ethnicity, was obtained from students. The child's care provider reported the number of people in the household, marital status, family history or medical problems, and level of parental education. Socioeconomic status was evaluated based on parental level of education, free or reduced lunch status, and number of people in the household.

Intensive Intervention: Baseline to 12 Weeks

Nutrition education component. Nutrition education consisted of teaching the children to distinguish between saturated and other fats, to lower the percentage of calories from fat, and to choose a variety of foods from all food groups. Children were trained to read food labels, select appropriately sized portions, and choose healthy foods when away from home. Another important component of the intervention was teaching them how to differentiate between appetite and hunger and how to recognize satiety.

A "traffic light program" food-coding system was used to teach participants how to categorize common food items into groups with different levels of health benefits. The intervention was adapted to the school environment and Mexican American children. Rules for determining how to categorize food groups were provided, and food groups were labeled "big bite," "portion rite," and "little bite." A food-coding system is an effective way to teach children nutrition concepts[40,41] that may have long-term maintenance benefits.[42] "Big bite" foods consisted mostly of fruits and nonstarchy vegetables. "Portion rite" foods included low-fat meats, low-fat dairy, and starches. "Little bite" foods consisted of foods with 5 or more grams of fat or 15 or more grams of sugar per serving.

Physical activity component. In order for the children to achieve at least 60 minutes of moderate to vigorous physical activity daily, as recommended by the US Department of Health and Human Services Physical Activity Guidelines for Americans,[43] the exercise component of the intensive intervention focused on gradually increasing physical activity and decreasing sedentary activity. Students participated in 45-minute physical activity training sessions four times per week.

Snacking intervention. Peanuts and peanut butter were provided to students daily as a nutrient-dense snack to promote satiety.[44] The serving size and energy content of the peanut and peanut butter snacks were as follows: peanuts, 1 oz (170 kcal); peanut butter, ¾-oz packet (120 kcal). Peanuts and peanut butter were selected because they are rich in the US Department of Agriculture Dietary Guidelines for Americans nutrients of concern and promote satiety.[25,28] Furthermore, there is evidence that peanut consumption in adolescence is associated with a healthier weight status, improved quality of diet, and lower lipid levels.[45] Inclusion of a consistent afternoon snack was an important component of the intervention because studies have shown that a consistent afternoon snack promotes satiety and decreases energy intake at the following meal.[29] In addition, pairing peanut butter with a variety of fruits and vegetables has been shown to be effective in increasing consumption and the willingness to try unfamiliar fruits and vegetables among Mexican American children.[46]

Maintenance Intervention: 4 to 6 Months

At the end of the 12-week intensive intervention, children continued to be offered peanuts and peanut butter snacks and participated in physical activity until the conclusion of the 6-month study.

Anthropometrics

Students' weight was measured with the participants wearing light clothing and no footwear. Height was obtained with a wall-mounted stadiometer. At baseline and 6 months, the BMI was calculated and the zBMI determined by using age- and gender-normative data.[47] In addition, at baseline and 6 months, triceps skin fold thickness was measured with calipers.[48] Skin fold thickness was used as a measure of excess body fat in the children.[49]

Dietary Adherence

At the end of 6 months, a peanut frequency questionnaire was used to assess food intake, with students rating how often they consumed peanuts or peanut butter per week (0, never; 1, once; 2, a few times; 3, almost every day). Specific questions asked children how often they ate peanuts, peanut butter sandwiches, peanut butter on crackers/toast/bagels/waffles, peanut butter with fruit, and peanut butter with vegetables. This questionnaire was created for the purposes of the current study. Split-half reliability of the questionnaire in this sample was good, with a Cronbach alpha of .71. Participants' responses to the peanut frequency questionnaires were totaled to create composite scores for all peanuts and

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all peanut butter items, with higher scores indicating higher adherence and lower scores indicating lower adherence. Composite scores were used to categorize students into low- and high- adherence groups.

Statistical Analysis

A cutoff score was computed to categorize students' adherence as low or high based on the 50th percentile. Because several participants' mean scores were equal to the mean, a determination was made randomly to place these individuals in the high-adherence group. Eating peanuts and/or peanut butter once or less per week was designated as low adherence, whereas consuming peanuts and peanut butter more than once a week was designated as high adherence. To evaluate differences between the baseline characteristics of the high- and low-adherence groups, *t*-tests were used. In addition, *t*-tests were used to evaluate changes in zBMI, BMI, weight, and triceps skin fold thickness by snacking adherence group. All statistical analyses were performed with IBM SPSS version 22, and the level of significance was set at $P < .05$.

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Results

The average age of the 257 students participating in the study was 12.0 ± 0.6 years (Table 1). The students included in this secondary analysis comprised an approximately an equal number of boys (48%) and girls (52%). At baseline, no significant differences in gender percentages and anthropometric measures were found between the high- and low-adherence groups (Table 1).

Based on the questionnaire results, children in the high-adherence group consumed peanut or peanut butter snacks 4.2 ± 2.5 per week (Table 2). In contrast, children in the low-adherence group consumed peanut or peanut butter snacks on average 0.5 ± 0.5 times per week. Further examination of the snacking patterns indicated that the children consumed peanuts 44% of the time and peanut butter 56% of the time.

Significant differences in body weight parameters between the high- and low-adherence groups were observed after 6 months (Table 3). Children in the high-adherence group showed greater positive anthropometric changes. Specifically, the high-adherence group had greater reductions in BMI (–0.7 vs –0.3, $P = .021$) and in zBMI (–0.2 vs –0.1, $P = .005$) compared with the low-adherence group. However,

analyses of changes in body weight and triceps skin fold revealed no significant differences between the groups at 6 months, although the results were trending toward significance.

Discussion

Regular and consistent snacks provided adolescent children weight benefits when they were incorporated into an intensive intervention program of nutrition education and physical activity. Mexican American children who were of an unhealthy weight and had the highest adherence to snacking demonstrated significantly greater decreases in zBMI and BMI at 6 months. Previous studies on snacking in general, however, have reported mixed results on the relationship of snacking and weight status.[28] Most studies have shown snacking to be positively correlated with overweight and obesity when children consume energy-dense "unhealthy snacks." In 2010, The Healthy, Hunger-Free Kids Act required the USDA to issue new "Smart Snacks in School" nutrition standards for competitive foods and beverages sold outside the federal reimbursable school meal program during the day.[50] Based on these standards, peanuts were one of the "smartest" snacks, with zero empty calories. Furthermore, the relatively high fat and protein content of peanuts helps to promote satiety while providing a healthy snack option for weight management. Future studies should examine the impact of other nuts on the satiety and weight status of children.

In this study, differences in weight loss among obese and overweight Mexican American children were compared according to adherence to peanut snacking after 6 months. Our findings revealed that a peanut snacking intervention was an effective component in reducing the BMI of children. Although weight loss and triceps skin fold changes were not significant after 6 months, the measurements were trending toward significance. Although peanuts represented a high-fat snack, satiety benefits likely helped maintain, if not decrease, the children's weight. Previously, Moreno and colleagues reported baseline findings regarding peanut consumption and body weight in 262 children in charter schools in Houston.[45] Participants completed a food frequency questionnaire as a baseline dietary assessment before beginning a weight management program. Children were identified as either peanut consumers (n = 100) or non-peanut consumers (n = 162). BMI measurements of the children at baseline revealed that peanut consumers were less likely to be overweight or obese than non-peanut consumers (P = .001).

In the Houston area, most school districts are not "peanut-free" facilities despite the concern of some parents regarding nut allergies.

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Parents provide schools with physician documentation of their child's peanut allergy, and schools make every effort to avoid providing any peanut products to these children. In 2012, the most common food allergy seen in urban low-income minority children was peanut allergy (1.6%); however, significantly more black children (4.7%) were affected than children of other races (2.7%, $P < .0001$), who were primarily Hispanic and multiracial children.[51] Recent findings, however, suggest that the early introduction of peanuts significantly decreases the development of peanut allergies among high-risk children. In a study of 530 infants between the ages of 4 and less than 11 months, either children were given peanuts or peanuts were avoided until they reached 60 months of age.[52] The prevalence of peanut allergies was 13.7% in the avoidance group compared with 1.9% in the group that had an early introduction of peanuts.[52] Thus, modification of the current pediatric guidelines to allow an earlier introduction of peanuts into children's diets may help to reduce the incidence of peanut allergies significantly.[52]

The strengths of this study include a large study sample and the use of an interventional rather than an observational study design. In addition, this study was undertaken with a group at high risk for obesity group as the prevalence of obesity among Mexican American children is one of the highest among all children.[53] Furthermore, peanuts and peanut butter were well accepted as a snack. However, a few study limitations should be noted. The consumption of peanuts and peanut butter was self-reported by the children. Although 52% of the children in Houston are Latino,[36] all children in the study were Mexican American. Therefore, generalizing findings to the entire population of children was not possible. In addition, there may have been a cultural mismatch between the intervention snacking program and the children despite efforts to make necessary adaptions for Mexican Americans. Thus, future research should include peanut snacking interventions in more ethnically diverse children and larger numbers of normal-weight children. Another limitation is that peanut allergies do occur among children, although in this sample of children, no participants were identified with peanut allergies. Finally, we did not collect other nutrition education or physical education data to control for adherence to the intervention program in the analysis.

In conclusion, schools and aftercare programs can replace energy-dense and unhealthy snacks with peanuts to provide an acceptable, healthy snack for children. In this study, the consumption of peanuts and peanut butter for 6 months provided weight health benefits, and high adherence to the peanut snacking intervention significantly decreased zBMI and BMI compared with low adherence. To allay parental concerns,

many schools now have adopted procedures to address children with known peanut allergies. Future policies to provide regular and consistent snacks of peanuts and peanut butter on a daily basis and at a predictable time of day (eg, an afternoon snack) could promote satiety and decrease energy intake at the following meal in many children at risk for obesity.

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Table1. Baseline characteristics by peanut snacking adherence.

Variable	All (n = 257) (mean ± SD)	High adherence (n = 145) (mean ± SD)	Low adherence (n = 112) (mean ± SD)	*P* value*
Age, y	12 ± 0.6	12 ± 0.6	12 ± 0.6	.89
Female, n (%)	133 (52%)	59 (44%)	74 (56%)	.80
Male, n (%)	124 (48%)	53 (43%)	71(57%)	.80
Height, cm	152.1 ± 7.4	152.0 ± 8.0	152.3 ± 6.7	.73
Weight, kg	63.3 ± 14.3	62.6 ± 14.8	64.2 ± 13.6	.39
BMI, kg/m^2	27.2 ± 4.6	26.9 ± 4.7	27.5 ± 4.5	.31
zBMI	1.8 ± 0.4	1.8 ± 0.4	1.9 ± 0.4	.24
Triceps skin fold, mm	25.8 ± 7.5	25.7 ± 7.2	26.0 ± 7.9	.33

SD, standard deviation; BMI, body mass index; zBMI, standardized BMI.

* $P < .05$ significant.

Table 2. Snacking frequency by peanut adherence group.

Snack frequency per week*	All (n = 257) (mean ± SD)	High adherence (n = 145) (mean ± SD)	Low adherence (n = 112) (mean ± SD)
Peanuts	0.9 ± 0.9	1.3 ± 0.8	0.3 ± 0.5
Peanut butter	1.7 ± 2.3	2.9 ± 2.9	0.2 ± 0.4
Total	2.6 ± 2.6	4.2 ± 2.5	0.5 ± 0.5

SD, standard deviation.

* 0, never; 1, once; 2, a few times; 3, almost every day.

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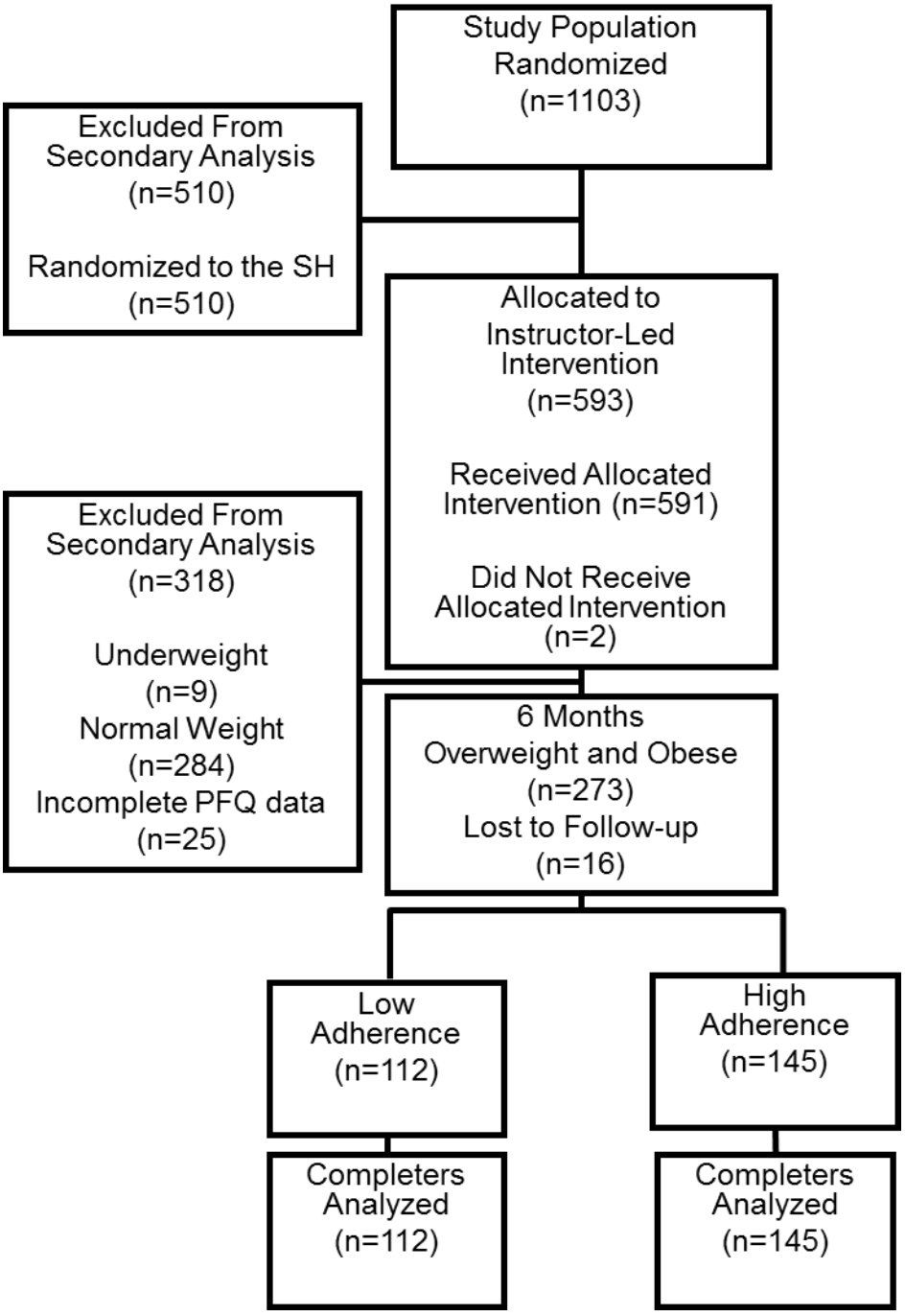
Table 3. Anthropometric changes by peanut snacking adherence.*

Change in scores from baseline to 6 mo	High adherence (n = 145) (mean ± SD)	Low adherence (n = 112) (mean ± SD)	*P* value*
Height, cm	3.2 ± 1.6	2.8 ± 1.6	.065
Weight, kg	0.9 ± 2.8	1.6 ± 2.7	.063
BMI, kg/m^2	–0.7 ± 1.2	–0.3 ± 1.2	.021
zBMI	–0.2 ± 5.5	–0.1 ± 0.2	.005
Triceps skin fold, mm	–1.7 ± 4.4	–0.3 ± 5.9	.097

* $P < .05$ significant.

Figure 1. Subject flow diagram. SH, self-help; PFQ, peanut frequency questionnaire.



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