



Original Research

Effect of Sedentary and Physical Activities on Children's Food Choice

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ABSTRACT

International Journal of Exercise Science 10(5): 702-712, 2017. Childhood obesity is a growing public health concern. Research has shown sedentary behavior (SB) increases children's unhealthy food consumption, while physical activity (PA) decreases caloric intake and increases energy expenditure. The purpose of this study was to examine child snack choice following a bout of active, SB, and a mix of SB and active (SB-A). Participants included a volunteer sample of children (n=24) ranging from 9-13 years of age. A within-subjects simple experimental design was used, and children participated in three conditions: active, SB, and SB-A. After each condition, the children were asked to choose one snack from two healthy and two unhealthy options. The children were randomized into one of the six possible condition sequences (4 children per group) based on when they enrolled in the study. Data were analyzed in SPSS (v21) using the Friedman, Wilcoxon Signed-Rank, and Kruskal-Wallis tests. There was not a statistically significant difference in the overall model comparing the three conditions on snack choice (p=0.15). Overweight/obese children were significantly more likely than normal weight children to choose a healthier snack option after the active condition (p=0.02). There was no difference between boys and girls for snack choice following the active (p>0.05), SB (p>0.05), and SB-A (p>0.05). Our overall findings suggest SB and active had no effect on children's snack choice. Promoting PA to children who are overweight/obese could lead to decreased energy intake and increased energy expenditure combating the obesity epidemic.

KEY WORDS: Exercise influence on child food consumption, weight status and food intake

INTRODUCTION

According to the Centers for Disease Control and Prevention (CDC), approximately 17% of children in the United States are obese (18). Height, age, weight, and gender are used to define Body Mass Index (BMI) in children (17). A BMI of ≥ 95 th percentile classifies children as obese

(17). Children who are overweight (85th to <95th percentile) or obese (\geq 95th percentile) are more likely to become overweight adults (25,27). Therefore, obesity is a pressing concern due to the negative health outcomes associated with this condition. Specifically, obese individuals have an increased risk for type II diabetes mellitus, hypertension, cardiovascular disease, and coronary heart disease (17).

Factors associated with the increase in childhood obesity include genetic, environmental, and modifiable lifestyle behaviors. Evidence suggests strategies that target modifiable lifestyle behaviors in children can be effective for combating the obesity epidemic (13). Specifically, understanding child food selection and consumption following sedentary or physically active pursuits may be one strategy towards obesity prevention. In children, it is unclear whether different activity levels influence energy intake. Some studies have shown that sedentary behaviors, such as increased television (TV) viewing will increase calorie-dense, nutrient-poor food consumption (6,12) In another study, where children participated in sedentary behaviors and physical activities, there was no difference in food intake (24). Conversely, other studies have shown children who participate in physical activity (PA) tend to decrease energy intake (3,26). On average, children consume 3 snacks per day, making up 27% of their daily total caloric intake (21). Snacking is defined as eating occasions different from main meals (breakfast, lunch, dinner/supper) (20). The largest increase in snack consumption has come from children choosing unhealthier, salty, and sweet options compared to healthy options (21). There are few studies related to influence of post sedentary behavior (SB) or physical activity (PA) on children's food choice, specifically healthy, nutrient-dense snacks compared to unhealthy, high-calorie, nutrient-poor snacks. There is a gap in the literature on snack choice (healthy vs unhealthy) immediately after PA and PA breaks within sedentary behaviors. This study will contribute to the understanding of how to reduce caloric intake in children and decrease obesity.

The purpose of this study was to examine the effect of PA and SB on children's subsequent snack choices. We hypothesized that children would choose a healthier snack option following the physically active condition compared to the sedentary condition. The secondary aim of this study was to examine the effect of gender on snack choice. We hypothesized that boys would choose less calorie-dense snacks than girls after all three conditions.

METHODS

Participants

A volunteer sample of children (n=24) ranging from 9-13 years of age was recruited. All children (n=24) who were recruited participated in the study. Participants were recruited from fliers posted throughout the community (e.g., YMCA, restaurants, grocery stores, etc.), school newsletters and electronically via community list serves. Participants were excluded from the study if: 1) they were physically disabled, 2) they could not participate in physical activities as recommended by a physician, or 3) they had any food allergies. When parents called in to sign up for the study, they were asked if their child had any food allergies or intolerances. Upon

completion of the study, the child and parent received financial compensation. The Institutional Review Board at the University of North Dakota approved this study.

The children participated in a within-subjects simple experimental design where all of the children were exposed to all three conditions (8,10). Sedentary behavior (SB): children were sedentary for 60 minutes. Active: children were physically active for 60 minutes at a moderate to vigorous intensity. A mix of SB and active (SB-A): children alternated between 15-minutes of SB and a 5-minute moderate intensity PA for a total of 60 minutes. In the SB-A condition the children started with SB. A research assistant participated in all three conditions to maintain motivational levels, as well as to ensure children performed the activities at the right intensity.

Immediately following each condition, the children chose between two unhealthy and two healthy food options. The children were randomized into order of receiving conditions based on when they enrolled in the study. Specifically, a total of 24 participants were recruited to ensure that four children were randomly placed in one of the six possible condition sequences. The four children participated in each condition at the same time. A visual display of the randomized allocation of subjects is provided in Figure 1.

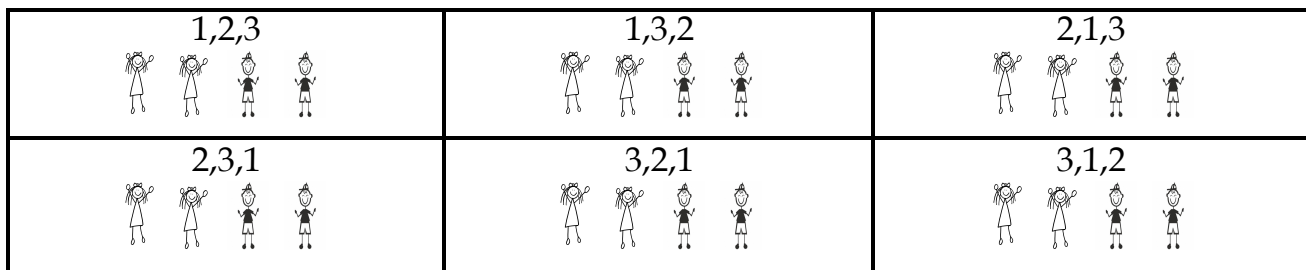


Figure 1. Participant randomization (1=SB, 2=Active, 3= SB-A).

Protocol

This study was conducted over three days/sessions within a three-week period. The child had his/her height in centimeters and weight in kilograms measured by a trained research assistant. While the child was getting his/her height and weight measured, the parent completed a survey which assessed what types of food are available in their house, sedentary and physically active behaviors of the child, and demographic information. Immediately following the measurements and survey completion, participants were taken to the laboratory where the research was conducted. For sessions two and three, the participants met at the laboratory where the previous research sessions were held.

In the laboratory during the three sessions, each child was asked to wear an accelerometer armband on his/her right arm that assessed caloric expenditure and activity level. The child was brought to a gym area where he/she completed one of the three conditions. The gym was set up accordingly for the conditions the child was randomly assigned. SB had a TV that only played movies. Active had different games and circuits set up. The games were 2-on-2 soccer and kickball in a racquetball court. The circuits consisted of activities such as: sprints, wheel barrel races, crab walks, grape vine, bear crawl, jump rope, hula hoop, jumping jacks, and

scooter races. SB-A allowed children to watch movies on the TV, and then participate in different types of circuit activities.

At the end of each session, the child went to a separate room where he/she chose what snack he/she wanted. The four food choices included two healthy and two unhealthy snack options. Only one child at a time was able to go into the room to choose his/her snack. The research assistant left the room so as not to influence the child's choice. The child came out of the room after he/she had chosen their snack, and the research assistant recorded which snack he/she chose after each condition. After session three, the child and parent were given financial compensation and thanked for their participation in the study.

Demographics - Demographic information was obtained by a self-report parent survey. Socioeconomic status was measured by one item assessing whether their child qualified for free or reduced lunch. Responses were used to determine the socioeconomic status of the family (low or high). Parent education level was assessed by report of highest level completed, ranging from some high school to post graduate school. Ethnicity for parent and child was reported separately (CDC). Parent and child gender was assessed. Lastly, parent and child age was reported by date of birth.

BMI - Height (cm) was measured using a portable stadiometer (Seco Corp, Model 213, Hamburg, Germany). Weight (kg) was measured using a digital scale (Seca Corp, Model 876, Hamburg, Germany). To ensure reliability, height and weight were measured twice, and if the first two measurements differed by more than 0.5cm or 0.1kg, respectively, a third measure was taken. The two closest measures were averaged and used to calculate BMI. Raw BMI scores were converted to percentiles using the CDC norm reference standards (15). Child weight status is based on their height, weight, age and sex where overweight was defined as $\geq 85^{\text{th}}$ to $<95^{\text{th}}$, and obese was $\geq 95^{\text{th}}$ percentile (15).

Availability - The parent survey assessed availability of food, PA equipment, and sedentary activities in their homes. For food availability, 28 fruits and 18 vegetables were listed and parents selected "yes" or "no" as to whether or not these items were available in the house (1,2). For PA availability, there were 20 different PA items listed as being available (yes) or not being available (no) for the parent to choose from (11). Lastly, for sedentary activity availability, there were seven different technologies (e.g., TV and computers) that promote SB. The parent was asked if the technologies were available in the home and/or in the child's room (4).

Child Behavior - On the parent survey, questions assessed children's food intake and the amount of time children spent being physically active or sedentary. For food intake, parents had two questions on fruit and vegetable servings per day for their child. The number of servings was 0-4 or more per day (19). There was also a question on how many times their child consumed fast food on a scale from 0 times per week to 2 or more times per day. For PA, there were two questions pertaining to how many days per week their child accumulates 60 minutes or more of PA (22). Lastly, for sedentary activity, there were four questions looking at

how much time their child spends in front of a screen to increase their time being sedentary (23).

Energy Expenditure - Children wore an armband accelerometer (SenseWear Pro Armband, Body Media, Pittsburg, PA) on their right arm. Each child wore the armband for an hour during each condition. The armbands were put on at the beginning of each condition. The accelerometer tracked the amount of calories expended during each condition. The SenseWear Pro is a reliable and valid measure for assessing PA energy expenditure (5).

Food Choice - Children were asked to choose one of four different snacks after completing each condition. The snack options included: Lay's Classic Potato Chip snack-sized bag (Calories=160, Total Fat= 10 grams (G), Total Carbohydrate= 15G, Protein=2G), Hershey's chocolate snack bar (Calories=190, Total Fat= 11 grams (G), Total Carbohydrate= 23G, Protein=3G), apple slices (Calories=80, Total Fat= 0 grams (G), Total Carbohydrate= 18G, Protein=0G), and baby carrots (Calories=35, Total Fat= 0 grams (G), Total Carbohydrate= 8G, Protein=1G). Salty and sweet snack options, chips and chocolate, make up the majority of snacking events (21). The apples and carrots are some of the sweetest fruits and vegetables.

Statistical Analysis

Due to a categorical dependent variable (snack choice), non-parametric statistics were necessary. The Friedman Test examined the effect of condition (Active, SB, SB-A) on snack choices. It was not necessary to control for order of receiving the condition, because all participants were randomized to receive one of the six possible orders. Post-hoc analysis included the Wilcoxon Signed Rank tests for each individual pairing (SB to Active; SB to SB-A; Active to SB-A).

The Kruskal-Wallis test compared snack choice between boys and girls for all three conditions, separately. Additionally, the Kruskal-Wallis test examined the difference in food choice between overweight and normal weight children.

Lastly, to predict snack choice from the parent survey variables, a logistic regression analysis was conducted. Healthy snacks were set as the reference group (=1) compared to unhealthy snacks. For all analyses, p-value was set at 0.05.

RESULTS

A total of 24 children (mean age=10.6 years, boys=13, girls=11, normal BMI=19) participated in the study. Participant characteristics are summarized in Table 1.

Overall, there was not a statistically significant difference in the overall model comparing the three conditions on snack choice ($p=0.15$; $\chi^2=3.8$). Table 2 illustrates the results of the Friedman test, and includes mean steps and kilocalories expended during each of the three conditions. The Wilcoxon Signed Rank Post-Hoc test was used to compare the three conditions to each

other (a total of three comparisons). The Wilcoxon Test showed no statistical significance ($p>0.05$): SB to active ($p=0.06$); active to SB-A ($p=0.41$); and SB to SB-A ($p=0.26$).

Table 1. Participant characteristics.

	Participant (n=24)
Sex: male	13 (54.2%)
female	11 (45.8%)
Mean Age, SD	10.6 (1.6)
Ethnicity: white	22 (91.7%)
no answer	2 (8.3%)
BMI:	
normal weight (<85 th percentile)	19 (79.2%)
overweight/obese (>85 th percentile)	5 (20.8%)
Free or Reduced Lunch:	
qualified	4 (16.7%)
did not qualify	20 (83.3%)
Physical Activity Guidelines:	
met	11 (45.8%)
did not meet	13 (54.2%)
Fruits and Vegetable Guidelines:	
met	5 (20.8%)
did not meet	19 (79.2%)
Screen Time Guidelines	
met	10 (41.7%)
did not meet	14 (58.3%)

Table 2. The comparison of the children's snack choice after each condition.

Condition	Mean (SD)	Average Steps	Average Calories Expended
SB	0.33 (0.5)	30	53.3
Active	0.54 (0.5)	4,842	258.6
SB-A	0.46 (0.5)	1,243	97.7

*no statistical difference from the Friedman Test Repeated Measures

To evaluate our secondary aim, we examined gender differences for snack choice following all three conditions (Figure 2). There was not a significant difference between boys and girls for snack choice after any of the active ($p>0.05$; $\chi^2=0.001$), SB ($p>0.05$; $\chi^2=0.322$) and SB-A ($p>0.05$; $\chi^2=0.595$) conditions. Thus, there was no difference between girls and boys on choosing a healthy or unhealthy snack option after a given condition.

Compared to normal weight children, overweight/obese children were more likely to choose a healthier snack option following the active condition ($p=0.02$; $\chi^2=1.63$). In the SB ($p>0.05$; $\chi^2=0.12$) and SB-A ($p>0.05$; $\chi^2=0.49$) conditions, however, there was no significance between snack choices when the overweight/obese children were compared to the normal weight children.

Table 3 illustrates the results of the logistic regression analysis for all three conditions, independently. Results showed that parent survey variables were not able to predict snack choice in children ($p>0.05$).

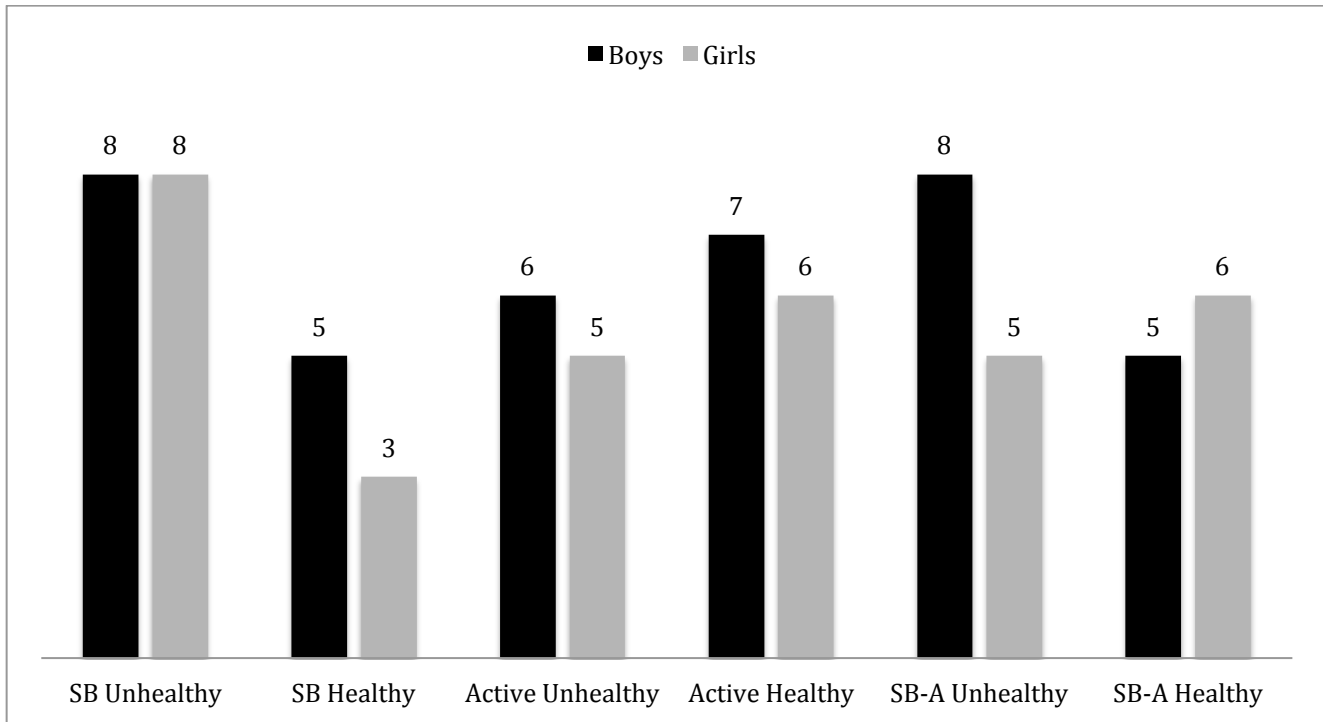


Figure 2. Snack selection after each condition based on gender.

Table 3. Results of Logistic Regression Analysis to Predict Child Snack Choice from Parent Survey Items

	Healthy	SB Unhealthy	Active Unhealthy	SB-A Unhealthy
Fruits Available	1	1.15	1.41	1.85
Vegetables Available	1	1.09	1.75	2.86
Snacks available	1	1.06	0.56	0.00
PA Equipment Available	1	1.05	1.05	3.31
Number of TVs in Home	1	0.49	1.20	0.10
Child's Minutes of Screen Time	1	1.00	0.98	1.04
Fruit and Vegetable Intake	1	1.77	0.57	2.27

***Note, p<0.05

DISCUSSION

To our knowledge, this is the first study investigating how sedentary and physical activity has an effect on children's snack choice. Contrary to our first hypothesis, there was no statistical significance between the three conditions for snack choice. Similarly, when examining our secondary aim, gender was not significant in comparing snack choice (healthy or unhealthy) between males and females after any of the three conditions. However, weight status of the children was significant when choosing a snack option after the active condition, suggesting overweight/obese children were more likely to choose a healthier snack option than the normal weight children. There was no significant difference between normal and overweight children when selecting a snack choice following the other two conditions (SB and SB-A).

An important aspect of this study was to examine whether children chose a healthier food option following the active compared to the SB condition. When comparing snack choice to all

three conditions, there was a non-significant effect. Although the post-hoc analysis illustrated a trend for significance following the SB condition, where children were more likely to choose an unhealthy snack after the SB compared to after the active condition.

The present study's results are consistent with those of other studies that have examined the relationship between sedentary behaviors and food consumption. Multiple studies have examined the effects of food consumption while watching TV, and children are more likely to consume calorie-dense, nutrient-poor food, when participating in sedentary activities with decreased energy expenditure (7,9). For every additional hour that children increase their TV viewing, they are more likely to consume an additional 167 kcals (28). Children who reduce the amount of time they eat in front of the TV will reduce their energy intake (9). Children who are sedentary are less likely to consume fruits, vegetables, whole-grain products and eat breakfast compared to children who engage in more than 60 minutes of PA daily (16). Thus, if children reduced the amount of time they are in front of the TV they may reduce their energy intake.

The secondary aim of the study was to examine whether boys chose less calorie-dense snacks than girls after all three conditions. In the present study, there was no significant gender effect on food choice. This study had similar results as other studies, however, these studies examined differences in food consumption after a meal (24,26). Different studies have shown varied results for gender effect on food choice in children. One study showed that girls compensate for 42% of their energy expended during a 45 minute exercise session (3). The boys in the same study showed a negative (-)13% compensation for food after the same session (3). Similarly, an intervention study was conducted to promote a decrease in TV; increased fruit and vegetable consumption; decreased high fat food intake; and increased moderate to vigorous PA (MVPA) in children, showed there was a difference between boys and girls (12). Both boys and girls decreased TV time, but only girls had a statistically significant decrease in energy intake and increased food consumption from the intervention to the control group (12). Thus, with varying results, it is crucial to keep examining the difference in gender for food consumption after sedentary and physical activities.

The present study, however, looked at a smaller portion of food, snack choice, instead of a full meal option. Three snacks make up 27% of the average child's total energy intake, where the rest of the energy intake is coming from meal consumption (21). Thus, one snack is roughly 9% of a child's total energy intake for the day. Several studies, however, have found differences in food consumption between boys and girls, which could be due to greater amount of calories in meals compared to snacks (3,12). The lower number of calories in this study could potentially be the reason why there was no significance in food consumption between genders.

The results from the present study indicate that overweight/obese children were more likely to choose a healthy snack option after active condition compared to the normal weight children. Other studies have shown comparable results (24,26). Thivel and colleagues (26) conducted a study demonstrating after an exercise session there was a total reduction in energy intake for the meals for the whole day compared to the sedentary session in obese

adolescents. Saunders and colleagues (24) examined whether normal weight children would compensate for energy intake with increased bouts of sedentary or PA. No compensation for food was reported during either condition (24). Our findings suggest that increasing the amount of PA overweight/obese children get on a daily basis could reduce their total energy intake by choosing less-calorie, nutrient-rich foods. It has been suggested that children ages 5-17 are conscientious of how much they weigh (16). The overweight children in this study could be partaking in weight loss strategies by choosing healthy instead of unhealthy food choices, following the active condition.

Research has shown the home environment has a large influence on children's food choices (14). Jago and colleagues (14) reported that children's fruit and vegetable consumption may be augmented by the availability of fruits and vegetables in the home. The current study, however, did not show a difference in home availability and child behaviors on child snack choice. Although this novel study was not in the home environment, it is crucial to continue to examine what influences children's snack choices outside of the home.

This is a small, exploratory study with several strengths and limitations. Strengths included that participants were randomized into one of six possible condition sequences. Second, groups were balanced for sex, 13 and 11, respectively. Third, a within-subject design exposed all participants to all conditions, so individual differences will not distort the results. Thus, each subject served as his or her own baseline. Fourth, PA and SB were objectively measured using accelerometers. Last, when the children chose their snack, they were placed in a room by themselves, so there was no bias influencing their snack choice.

Potential limitations included siblings participating in the study and sample size. There could be a bias with participants who were from the same family. The participants could potentially talk after they went home about their snack choices. This could influence their choices when they come in for the next session. However, we do not have evidence of this. Secondly, as this was a novel, pilot study we wanted to investigate the relationship between activity and energy intake, thus leading to a small sample size. Additionally, the small overall sample size made it difficult to find significant differences between the subsample groups.

In conclusion, there was no statistical significance between the three conditions on snack choice, as well as, no differences between gender. Our findings suggest overweight/obese children tend to choose healthier snack options after a 60 minute bout of PA. Promoting PA to children who are overweight/obese could potentially lead to weight loss overtime by decreasing energy intake and increasing energy expenditure. The results of this study could potentially influence obesity intervention programs by placing more emphasis on healthier snack options immediately following PA sessions. Future studies should reproduce this study with a larger sample of overweight and obese children. This could further our understanding on children's snack preferences after different activities to help control excess caloric intake to prevent children from gaining additional weight. Future studies could also examine what influences children's snack choice outside of the home.

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