Journal of Childhood Obesity
ISSN: 2572-5394

Open access Research Article

# A Model for Promoting Healthy Weight-Behaviors in Under-Resourced Children Attending Afterschool programs

**Bernestine McGee[1*], Glenda Johnson[1], Dachuan Zhang[2], William Johnson[2]**

*[1]Department of Human Nutrition and Food Program, Southern University and A & M College, United States*
*[2]Department of Biostatistics and Analysis, Pennington Biomedical Research Center, United States*

## ABSTRACT

**Objective:** Overweight and obesity and the associated chronic conditions are a continuing health risk for children resulting in a need for novel childhood obesity prevention approaches. After school programs have great potential to provide opportunities for increasing knowledge and practice of healthy eating and physical activity behaviors of enrolled children. This pragmatic trial investigated the feasibility of the SPARK (Sports, Play and Active Recreation for Kids) PLUS intervention which can be a model for promoting healthy weight-related behaviors in under-resourced children attending after school programs.

**Methods:** 97 African American children aged 8-14 years participated in the trial using a randomized block design with blocks being afterschool sites; pre-post assessments.

**Results:** Diet quality and nutrition knowledge and physical activity-related behaviors (primary outcomes) and BMI-z scores (secondary outcome) assessed intervention effectiveness. Significant group differences in changes were detected in HEI total protein (P=0.04) and sodium (P=0.03) scores, consumption of 100% fruit juice (P=0.02) vegetables at dinner (P=0.01) and was more likely to be physically active 3-5 times a week (P=0.02).

**Conclusion:** Positive outcomes were observed suggesting feasibility of the intervention. Results contribute to limited evidence on obesity prevention models for African American children in after-school settings. SPARK PLUS is a promising model to promote healthful behavior among students since academic demands placed on traditional school-hours limit nutrition and physical education opportunities.

**Keywords:** After-school nutrition and physical activity; Childhood obesity prevention; African American children

## INTRODUCTION

Childhood obesity continues to be a major health concern in the United States placing children and adolescents at risk for poor health, and for developing obesity-related health conditions once thought applicable only to adults [1-3]. The latest national data show that the obesity rates are significantly higher for non-Hispanic Black (23.8%) and Hispanic (21.4%) children than for non-Hispanic white (12.1%) children ages 10-17 [4]. Research on new and more effective approaches is needed to address the childhood obesity epidemic [5]. According to Kumanyika et al, high priority should be given to supporting and conducting studies of weight-related interventions with Black children in clinical and community settings. Afterschool programs (ASPs) are emerging as promising settings for childhood obesity prevention interventions since academic demands placed on schools during traditional school-hours limit accessibility to students in providing healthy eating and physical activity information [6,7].

| | | | |
|---|---|---|---|
| **Received:** | 30-August-2022 | **Manuscript No:** | IPJCO-22-14503 |
| **Editor assigned:** | 01-September-2022 | **PreQC No:** | IPJCO-22-14503 (PQ) |
| **Reviewed:** | 15-September-2022 | **QC No:** | IPJCO-22-14503 |
| **Revised:** | 20-September-2022 | **Manuscript No:** | IPJCO-22-14503 (R) |
| **Published:** | 27-September-2022 | **DOI:** | 10.36648/2572-5394.22.7.114 |

**Corresponding author** Bernestine B. McGee, Department of Human Nutrition and Food Program, Southern University and A & M College, United States, Tel: 225-774-7499; E-mail: Bernestinebmcgee@gmail.com

**Citation** McGee BB, Johnson G, Zhang D, Johnson W (2022) A Model for Promoting Healthy Weight-Behaviors in Under-Resourced Children Attending Afterschool programs. J Child Obesity. 7:114.

Almost 20% of children in the United States participate in an ASP. Black children represent a larger share of children attending ASPs, growing from 15 percent in 2014 to 19 percent in 2020 [7].

The Afterschool Alliance, a nonprofit organization dedicated to raising awareness of the importance of afterschool programs, developed specific policy and program recommendations that can make the continuing expansion of afterschool in America most effective in combating obesity and promoting healthy life habits [8]. One program recommendation states, "Develop and implement tools for assessment of a program's impact on free-time physical activity, general fitness, and nutrition behaviors of participants. Share results with the afterschool field and the obesity prevention community" [8].

The National AfterSchool Association (NAA) is also committed to health promotion and contributing to the afterschool obesity prevention agenda. The association developed the Healthy Eating Physical Activity (HEPA) Standards that provide comprehensive guidance that fosters the best possible nutrition and physical activity outcomes for children and youth attending outside-of-school time (OST) programs. The HEPA Standards consist of five content areas and accompanying set of standards. The first Content Area includes standards that translate nutrition and physical activity science into actions that OST programs can use to offer health-promoting foods, beverages, and physical activity. The remaining four Content Areas have standards that address staff training, social supports, program support, and environmental support [9]. Many afterschool programs leaders have taken the initiative to address the childhood obesity issue by integrating nutrition and physical activity promotion into their existing structure.

However, recent survey findings reported in the America After 3 PM Report suggested that more work needs to be done to increase healthy food options and physical activity in afterschool programs, especially in afterschool programs serving higher-need students [10].

A variety of obesity prevention models have been developed and implemented in ASPs. The literature reflects studies that evaluated the effect of variables, such as, physical activity, nutrition education, environment, psychosocial interactions and diet and physical activity combined on obesity risks in children in outside-of-school settings. Researchers reviewing the effectiveness of childhood obesity prevention interventions found interventions that were multi-component (e.g., targeting physical activity and nutrition), involved parents and school staff, and theoretically informed had greater effects on child weight status [11-22].

Currently, there is a paucity of research examining models designed to promote healthy weight-related behaviors in under-resourced African American children attending afterschool programs. Using the best practices reported in the literature, we developed the SPARK PLUS Afterschool Intervention (SPARK PLUS) to reduce behavioral risks related to childhood obesity in this high-risk subpopulation. The current study aims to evaluate the feasibility of the SPARK PLUS intervention which can be a model for promoting healthy weight-related behaviors in under-resourced children attending after school programs. We posited that an intervention focused on nutrition education and physical activity opportunities for African American children participating in an afterschool program would result in greater improvement in their diet quality, nutrition and physical activity knowledge, behaviors, intentions, and BMI z-scores, than children who did not participate in the intervention. The Social Cognitive Theory (SCT), the most used theoretical framework underlying interventions to promote physical activity and healthy eating and prevent obesity in youth, guided the development and implementation of the intervention [23,24]. The Institutional Review Board of Southern University and A&M College approved this study and all participants provided written informed consent.

# METHODS

## Participants

Children who volunteered to participate in the intervention were predominately African American from low-income families. Children were grouped by the after-school sites they attended. An average of 10-15 children participated in intervention sessions. Over the two-and half-year trial, 72 children in the intervention group and 25 in the comparison group completed pre/post intervention assessments. Children were compensated $ 50 ($ 25 at baseline and $ 25 at post intervention) for their involvement.

## Procedure

A four-week pilot study was conducted prior to implementing the pragmatic pre/post group randomized controlled trial. This was an opportunity to practice implementing the experimental procedures of the study, and to correct identified problems.

The main study was conducted at Big Buddy Afterschool Program (BBAP) sites that were housed in four elementary schools. BBAP is a nonprofit community organization that offers afterschool programs in schools in Baton Rouge, Louisiana. Schools designate classrooms, cafeterias, and gyms for the BBAP to conduct its academic and enrichment activities. Seven study sites were enlisted. Study participants were individually randomized into intervention group (SPARK PLUS) or comparison group. Two sites received both intervention and comparison, and 5 sites received either intervention or comparison. Therefore, the study used a randomized incomplete blocks design. SPARK PLUS was added to the listing of enrichment activities offered at the intervention sites. Recruitment of children included announcements by school officials, presentations at parents' informational meetings, and posted flyers. The total enrollment of 8–14-year-old children attending the selected BBAP study sites was 287. A power analysis determined that 142 children (2 sites) were needed in the intervention group and 145 students (3 sites) in the comparison group to detect a statistically significant effect of 80%. Recruiting the number of children required to power a trial is not always feasible; therefore, our goal was to collect pre-post intervention study data on a sufficiently large number of children to provide informative inferences pertaining to potentially beneficial changes in study outcomes.

## Instruments

Demographic data were collected on both groups of children at baseline. Study data were collected at baseline and post intervention. Changes in Healthy Eating Index-2015 (HEI-2015) scores were used to assess diet quality. HEI is a measure of diet quality that assesses conformance to the Dietary Guidelines for Americans. A score of 81 indicate good diet quality [25]. Food intake was assessed using 24 hour dietary recall. Trained data collectors

assisted children in recording dietary data. School menus were used to help children who consumed school breakfast and lunch remember foods they were unable to recall. Recalls were analyzed and HEI scores determined by the Nutritional Epidemiology Dietary Assessment and Counseling Core at the Pennington Biomedical Research Center.

CATCH Kids Club After-School Student Questionnaire (ASSQ), self-administered, 55-item questionnaire was used to measure the impact of the intervention on children's nutrition and physical activity knowledge, attitudes, intentions to choose healthful food options and participate in sports activities. The ASSQ has an acceptable internal consistency (greater than 0.6) [26]. Trained data collectors assisted children in completing the questionnaire which took approximately 20-25 minutes. Twenty-two items relative to the child's previous day's intake of fruits, vegetables and snacks, general food preferences and food choices in selected scenarios were used to evaluate their dietary behaviors.

To measure physical activity, children responded to items related to their participation in sports, exercise, and screen activities. Trained research assistants assessed children's weight and height using standard measurement protocol. BMI z-scores were derived from the norm reference standards for growth by age and gender. BMI rankings were categorized as a BMI percentile, <5$^{th}$ percentile underweight, 5$^{th}$ to <85$^{th}$ percentile healthy weight, 85$^{th}$ to <95$^{th}$ percentile overweight and ≥ 95$^{th}$ percentile obese [27].

## Intervention

The 16 week SPARK PLUS intervention included nutrition education, physical activity, staff training, parental engagement, and healthy snacks. Physical activities were selected from SPARK After-School Program [28] and healthy eating lessons adapted from nutrition educational resources [28,29]. Class content, activity sheets, games, goal setting and reinforcement actions were identified and made culturally relevant using pictures, food, scenarios, and communication patterns that reflected the culture of the children. Encouraging statements and affirmations were incorporated into class and physical activities to promote the children's self-efficacy and confidence. The intervention was led by a healthy lifestyle promoter, who was college educated in nutrition education and trained for the intervention. She was assisted by college student volunteers and BBAP staff. Children in the comparison group participated in regular BBAP homework and enrichment activities.

Nutrition education classes were conducted at the intervention sites, two days a week, for 30-45 minutes. Classes included discussions of healthy eating topics, hands-on activities, take home handouts, and preparation or demonstration of a healthy snack. A highlight of the sessions was creating container gardens that students maintained through the duration of the program. Topics and descriptions of classes are shown in **Table 1**.

**Table 1:** Weekly Nutrition Education Topics and Class Summaries.

| Topic | Class Summary |
|---|---|
| **Lessons 1-2:** S.M.A.R.T. Goals, MyPlate, Variety, Moderation and Balance | **Take-home Message:** "MyPlate is a tool I use to make healthy food choices and set personal health goals." Session activities: Discussion topics: "Why do we eat?" "What is a healthy diet?" "What are the benefits of a healthy diet?" Prepare a simple healthy snack. |
| **Lesson 3:** Nutrients | **Take-home Message:** "Nutrients help me look and feel my best." Session activities: Discuss food nutrients, complete Nutrient Tracker Worksheet, play Food Group Game. |
| **Lessons 4-5:** Fruits and Veggies | **Take-home Message:** "I fill half my plate with a variety of colorful (rainbow) fruits and vegetables." Session activities: Watch/discuss fruit and vegetables video, survey fruit and vegetable habits; prepare apple slaw and fruit smoothie recipes. |
| **Lessons 6-7:** Container Gardening | **Take-home Message:** "Tasty nutritious vegetables can be grown at home." Session activities: Discuss the basics of home vegetable gardening, start a container garden. |
| **Lesson 8:** Breakfast: Whole Grains and Fiber | **Take-home Message:** "Eating a healthy breakfast gives me GO POWER for the day." "Session activities: Discuss breakfast benefits, rank cereals, sample whole grain cereals |
| **Lessons 9-10:** GO, SLOW, and WHOA Foods | **Take-home Message:** "Enjoy GO and SLOW foods and eat less WHOA foods." Session activities: Identify GO, SLOW and WHOA foods, modify meals game, prepare a GO snack. |
| **Lessons 11-12:** Salt and Sodium Find their Way into the Day | **Take-home Message:** "Choose fewer salty foods." Session activities: Discuss major sodium sources, sodium in fast foods, making lower sodium choices, complete What Can You Order Worksheet, prepare Fruit Kebobs. |
| **Lesson 13:** Explore Labels | **Take-home Message:** "Reading food labels helps us make healthy food choices." Session activities: Discuss major aspects on food labels, prepare Peanut Butter Banana Roll Ups. |
| **Lesson 14:** What's in Your Glass? | **Take-home Message:** "Drink water instead of sugary drinks." Session activities: Discuss benefits of water, complete What's in Your Glass worksheet, prepare fruit/vegetable infused water. |
| **Lesson 15:** Why Start a Snack Attack? | **Take-home Message:** "Eat sugary snacks less often." Session activities: Discuss sugar in sodas and packaged bakery desserts, complete Snack Attack Worksheet, prepare fruit dip and pita chips. |
| **Lesson 16:** Screen-Time | **Take-home Message:** "Limit screen-time to two hours a day." Session activities: Discuss activities children can perform in place of screen time activities, strategies to combat barriers that prevent children from physical activity, perform Bayou Bookie Dance. |

Children engaged in organized physical activities two-three days per week, on days when nutrition education sessions were not scheduled. The school gym or outdoor play environment was transformed with SPARK After-School Program equipment that stimulated enthusiasm for participating in physical activities [30]. Children engaged in at least 30 minutes of moving of moderate to vigorous physical activity (MVPA) levels. Emphasis was on having fun and enhancing self-efficacy to be physically active.

SPARK PLUS Virtual Classroom was developed for parents, using an online learning management system. SPARK PLUS ONLINE was an accessible online healthy lifestyles site designed to provide a supportive environment for parents to encourage healthy food and physical activity behaviors in themselves and their children. Parents of children in the comparison group received adapted parenting information [31,32].

## Data Analysis

Descriptive statistics including counts, percent, and standard deviations were used to compare the baseline demographic characteristics and dietary HEI scores. The goal for statistical analysis of trial outcomes was to assess statistical significance of changes observed in outcomes from baseline to follow-up in response to the intervention. Specific aim was to identify indicators of improvement in diet quality and BMI-z-scores that may have resulted due to trial intervention. We performed a completer analysis, whereby a child's data were included in the analysis only if baseline and follow-up data were both available, thus missing data were not an issue. Our outcomes were analyzed using a generalized linear mixed effects (i.e., fixed, and random) statistical model where fixed effects are intervention and gender, and random effects are sites and subjects within sites. Note that the sites are also referred to as clusters where clusters are groups of participants (subjects). Analysis of residuals of the model indicated that they do not depart from the assumption of normality.

The statistical model is expressed as:

$$\text{Change in outcome}_{ijk} = \beta_0 + \beta_1 * \text{group}_i + \beta_2 * \text{gender}_j + \text{site}_k + e_{ijk}$$

Where $\text{site}_k$ is the random effect of each site on the intercept, which effectively adjust for the intraclass correlation coefficient (ICC) with numeric value equals to 0.59. This model-based approach provides a well-established framework for estimating influences of intervention program activities and gender, and for testing statistical significance of observed differences in estimates between intervention and control. Effect size was computed as the difference between groups divided by the standard deviation of the difference. All statistical analyses were performed with alpha=0.05 using SAS software, Proc Mixed, version 9.4 [33].

# RESULTS

One hundred and twenty children attending a BBAP selected SPARK PLUS as their enrichment activity for the semester. A total of 97 children completed both pre and post measures. Of the children, 47.4% (n=46) were girls and 52.6% (n=51) were boys. The average age of the girls was 9.20 years and that of the boys was 9.26 years. With exception of weight of boys in the comparison group, demographic characteristics did not differ between the groups at baseline. There were no significant differences between the intervention and comparison group regarding changes in weight status. Demographic, anthropometric characteristics and weight categories are presented in **Table 2**.

**Table 2:** Descriptive Characteristics, Anthropometric Parameters, Caloric Intake, and HEI Scores at Baseline and Post Intervention by Intervention and Comparison Groups.

| | Comparison | | | | Intervention | | | |
|---|---|---|---|---|---|---|---|---|
| | Pre-Intervention | | Post-Intervention | | Pre-Intervention | | Post-Intervention | |
| Variable | Boys (n=13) | Girls (n=12) | Boys (n=13) | Girls (n=12) | Boys (n=38) | Girls (n=34) | Boys (n=38) | Girls (n=34) |
| Age (yrs) | 9.51 ± 1.59 | 9.38 ± 1.9 | 9.77 ± 1.42 | 9.67 ± 1.73 | 9.59 ± 1.33 | 9.44 ± 1.1 | 9.71 ± 1.27 | 9.55 ± 1.04 |
| Stature (cm) | 137.66 ± 10.41 | 141.25 ± 14.08 | 138.86 ± 9.9 | 142.94 ± 12.23 | 139.76 ± 9.32 | 138.04 ± 10.87 | 141.72 ± 8.84 | 138.91 ± 10.61 |
| Weight (lb) | 77.18 ± 28.62 | 102.91 ± 61.4 | 82.1 ± 25.27 | 107.42 ± 54.79 | 87.71 ± 36.25 | 85.55 ± 43.23 | 93.04 ± 36.44 | 88.7 ± 43.31 |
| BMI (kg/m$^2$) | 18.31 ± 6.31 | 21.74 ± 9.61 | 19.24 ± 5.56 | 22.44 ± 8.57 | 20.1 ± 5.85 | 19.58 ± 6.54 | 20.72 ± 5.77 | 20.08 ± 6.47 |
| <5$^{th}$ percentile BMIz | . | . | . | . | . | 1 | . | . |
| 5$^{th}$ to <85$^{th}$ percentile BMIz | 9 | 8 | 11 | 6 | 23 | 21 | 21 | 21 |
| 85$^{th}$>95$^{th}$ percentile BMIz | 1 | 2 | . | . | 5 | 3 | 7 | 3 |
| >95$^{th}$ percentile BMIz | 3 | 2 | 1 | 6 | 10 | 9 | 11 | 9 |
| Calories | 1268.75 ± 389.34 | 1250.92 ± 376.27 | 1465.63 ± 667.39 | 1110.67 ± 618.14 | 1340.5 ± 392.7 | 969.4 ± 647.74 | 1463.25 ± 176.7 | 962.2 ± 513.59 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Total HEI score=100 | 41.56 ± 12.24 | 50.29 ± 11.56 | 42.16 ± 13.1 | 51.13 ± 9.58 | 38.65 ± 8.64 | 46.76 ± 12.7 | 49.28 ± 16.59 | 50.27 ± 9.01 |
| | | | | **Adequacy** | | | | |
| Total fruit=5 | 1.22 ± 2.26 | 2.96 ± 2.15 | 0.89 ± 1.7 | 2.96 ± 2.33 | 1.12 ± 2.24 | 2.8 ± 2.59 | 0.03 ± 0.06 | 3.14 ± 2.04 |
| Whole fruit=5 | 1.25 ± 2.31 | 2.24 ± 2.4 | 0.81 ± 1.48 | 1.99 ± 2.37 | 0.23 ± 0.46 | 2 ± 2.74 | 0 ± 0 | 2.78 ± 2.43 |
| Total vege-tables=5 | 2.07 ± 1.58 | 2.02 ± 1.71 | 2.37 ± 1.64 | 2.1 ± 1.87 | 1.67 ± 0.95 | 2.64 ± 1.9 | 2.97 ± 1.53 | 1.33 ± 1.31 |
| Greens and beans=5 | 1.11 ± 2.08 | 1 ± 1.66 | 0.56 ± 1.58 | 1.9 ± 2.42 | 0.6 ± 1.21 | 1 ± 2.24 | 2.5 ± 2.89 | 2 ± 2.74 |
| Whole grains=10 | 0.97 ± 1.21 | 1.24 ± 2.26 | 1.73 ± 3.52 | 0.89 ± 2.47 | 0 ± 0 | 1.48 ± 3.31 | 1.15 ± 1.47 | 1.78 ± 3.24 |
| Dairy=10 | 5.64 ± 3.56 | 5.07 ± 3.61 | 2.83 ± 3.55 | 6 ± 3.82 | 4.24 ± 3.9 | 3.75 ± 3.98 | 3.15 ± 3.06 | 6.61 ± 3.87 |
| Total protein foods=5 | 4.96 ± 0.11 | 4.34 ± 1.06 | 4.44 ± 1.31 | 3.74 ± 1.77 | 3.4 ± 2.34 | 2.22 ± 2.05 | 5 ± 0 | 3.83 ± 2.17 |
| Seafood/ plant pro-teins=5 | 1.12 ± 2.08 | 1.67 ± 2.46 | 0 ± 0 | 1.8 ± 2.3 | 1.88 ± 2.4 | 0.02 ± 0.05 | 2.5 ± 2.89 | 1 ± 2.24 |
| Fatty acids=10 | 4.05 ± 4.58 | 6.4 ± 3.34 | 6.05 ± 3.22 | 4.6 ± 3.87 | 2.59 ± 4.94 | 6.57 ± 4.49 | 7.32 ± 3.42 | 4.81 ± 3.42 |
| | | | | **Moderation** | | | | |
| Refined grains=10 | 4.85 ± 2.71 | 5.89 ± 4.45 | 6.01 ± 3.49 | 4.71 ± 4.39 | 6.14 ± 4.33 | 2 ± 4.47 | 5.15 ± 4.32 | 6.13 ± 3.66 |
| Sodium=10 | 2.65 ± 2.34 | 4.96 ± 3.51 | 6.76 ± 3.41 | 5.62 ± 3.79 | 8.38 ± 2.83 | 7.31 ± 2.33 | 6.75 ± 4.51 | 4.07 ± 4.26 |
| Added sugars=10 | 7.47 ± 2.96 | 6.9 ± 3.45 | 4.46 ± 3.21 | 7.27 ± 3.92 | 4.54 ± 4.86 | 8.99 ± 1.78 | 6.32 ± 3.29 | 8.12 ± 1.92 |
| Saturated fats=10 | 4.21 ± 2.97 | 5.6 ± 3 | 5.25 ± 3.82 | 7.54 ± 2.8 | 3.88 ± 2.76 | 5.98 ± 2.82 | 6.46 ± 3.66 | 4.68 ± 0.69 |

Results are expressed as Mean ± Standard Deviation except for BMI z percentile categories, which are expressed as n.

Diet quality scores at baseline and end of the trial are shown in Table 2. Girls in both groups had higher total HEI scores compared to boys at baseline and post intervention. Although not significant, the total HEI score for the intervention group (49.83) was higher than the comparison group (47.54) post intervention. The intervention group also had higher scores than the comparison group in most subcategories. Significant group differences in changes were detected in HEI total protein and sodium scores: 2.17 ± 0.98 (0.14, 4.20) P=0.04; -4.82 ± 2.04(-9.06, -0.58) P=0.03 respectively (**Table 3**).

**Table 3:** Group Differences for Healthy Eating Index (HEI) Indicators.

| Variables | Comparison | Intervention | Difference | P value | ES* |
|---|---|---|---|---|---|
| Calories | -20.87 ± 253.1 (-545.76, 504.03) | 39.4 ± 343.94 (-673.87, 752.68) | 60.27 ± 427.03 (-825.33, 945.87) | 0.89 | 0.03 |
| Total HEI score | 0.72 ± 3.83 (-7.23, 8.67) | 7.06 ± 5.63 (-4.62, 18.75) | 6.34 ± 6.82 (-7.79, 20.48) | 0.36 | 0.17 |
| | | **Adequacy** | | | |
| Total fruit | -0.17 ± 0.64 (-1.50, 1.16) | -0.38 ± 0.94 (-2.33, 1.58) | -0.21 ± 1.14 (-2.58, 2.16) | 0.86 | -0.03 |
| Whole fruit | -0.55 ± 0.97 (-2.56, 1.45) | 0.27 ± 1.32 (-2.48, 3.01) | 0.82 ± 1.64 (-2.58, 4.22) | 0.62 | 0.09 |
| Total vegetables | 0.20 ± 0.51 (-0.86, 1.25) | 0.00 ± 0.75 (-1.55, 1.55) | -0.20 ± 0.90 (-2.07, 1.68) | 0.83 | -0.04 |
| Greens and beans | 0.21 ± 0.86 (-1.57, 1.99) | 1.60 ± 1.24 (-0.97, 4.16) | 1.38 ± 1.51 (-1.74, 4.51) | 0.37 | 0.17 |
| Whole grains | 0.21 ± 0.81 (-1.48, 1.90) | 0.69 ± 1.19 (-1.77, 3.16) | 0.48 ± 1.44 (-2.50, 3.47) | 0.74 | 0.06 |
| Diary | -0.94 ± 1.16 (-3.33, 1.46) | 0.88 ± 1.70 (-2.64, 4.41) | 1.82 ± 2.05 (-2.44, 6.08) | 0.39 | 0.16 |
| Total protein foods | -0.56 ± 0.55 (-1.70, 0.58) | 1.61 ± 0.81 (-0.07, 3.29) | 2.17 ± 0.98 (0.14, 4.20) | 0.04 | 0.41 |
| Seafood/plant protein | -0.49 ± 0.94 (-2.44, 1.46) | 0.88 ± 1.35 (-1.93, 3.69) | 1.37 ± 1.65 (-2.05, 4.79) | 0.42 | 0.15 |

| | | | | | |
|---|---|---|---|---|---|
| Fatty acids | 0.10 ± 1.27 (-2.54, 2.74) | 1.48 ± 1.87 (-2.40, 5.36) | 1.38 ± 2.27 (-3.32, 6.08) | 0.55 | 0.11 |
| **Moderation** | | | | | |
| Refined grains | -0.08 ± 1.94 (-4.10, 3.94) | 1.61 ± 2.62 (-3.82, 7.05) | 1.70 ± 3.26 (-5.06, 8.46) | 0.61 | 0.1 |
| Sodium | 2.39 ± 1.15 (0.00, 4.77) | -2.44 ± 1.69 (-5.94, 1.07) | -4.82 ± 2.04 (-9.06, -0.58) | 0.03 | -0.44 |
| Added sugars | -1.01 ± 1.67 (-4.47, 2.45) | 0.21 ± 2.27 (-4.50, 4.91) | 1.22 ± 2.82 (-4.62, 7.06) | 0.67 | 0.08 |
| Saturated fats | 1.57 ± 1.04 (-0.58, 3.72) | 0.78 ± 1.49 (-2.31, 3.87) | -0.79 ± 1.81 (-4.55, 2.97) | 0.67 | -0.08 |

Results are expressed as Estimate ± Standard Error (95% confidence interval).
Results are adjusted for gender. *Effect Sizes

**Table 4** displays selected dietary behaviors, intentions, and physical activity from the ASSQ. The values reflect significant and near significant changes in physical activity and food behavior items. Compared to baseline, the intervention group consumed significantly more 100% fruit juice and vegetables at dinner than comparison group: 0.42 ± 0.18 (0.07, 0.77) P=0.02; 0.61 ± 0.21 (0.19, 1.03) P=0.01, respectively.

**Table 4:** Selected Measures from Child and Adolescent Trial for Cardiovascular Health (CATCH) Kids Club After-School Student Questionnaire for Dietary Behavior, Intentions, Knowledge, and Physical Activity of Comparison and Intervention Groups.

| Variable | Group | | | | |
|---|---|---|---|---|---|
| | Comparison | Intervention | Difference | P Value | ES* |
| Do you ever | | | | | |
| Drink 100% fruit juice (CATCH-Q 23) | -0.15 ± 0.14 (-0.43, 0.13) | 0.27 ± 0.11 (0.06, 0.48) | 0.42 ± 0.18 (0.07, 0.77) | 0.02 | 0.24 |
| Eat vegetables for dinner (CATCH-Q 25) | -0.34 ± 0.17 (-0.68, -0.01) | 0.27 ± 0.13 (0.01, 0.52) | 0.61 ± 0.21 (0.19, 1.03) | 0.01 | 0.29 |
| **Which would you choose** | | | | | |
| Regular or low-fat/slim milk (CATCH-Q 27) | 0.08 ± 0.1 (-0.13, 0.28) | -0.11 ± 0.08 (-0.27, 0.04) | -0.19 ± 0.13 (-0.44, 0.07) | 0.15 | -0.15 |
| Cook French fries or baked potatoes (CATCH-Q 31) | -0.11 ± 0.15 (-0.40, 0.19) | 0.09 ± 0.13 (-0.18, 0.35) | 0.19 ± 0.12 (-0.05, 0.44) | 0.13 | 0.16 |
| Eat cooked vegetables with or without butter (CATCH-Q 32) | 0.10 ± 0.11 (-0.12, 0.32) | -0.12 ± 0.08 (-0.28, 0.04) | -0.22 ± 0.14 (-0.49, 0.05) | 0.11 | -0.17 |
| **Likely to eat some foods** | | | | | |
| Take skin off chicken to eat (CATCH-Q 37) | -0.10 ± 0.16 (-0.43, 0.23) | 0.25 ± 0.13 (0.00, 0.5) | 0.35 ± 0.21 (-0.06, 0.76) | 0.1 | 0.17 |
| **Which is better for health** | | | | | |
| Cereal or eggs and bacon (CATCH-Q 44) | -0.13 ± 0.11 (-0.34, 0.09) | 0.07 ± 0.09 (-0.10, 0.25) | 0.20 ± 0.12 (-0.04, 0.45) | 0.1 | 0.17 |
| Regular or low fat/skim milk (CATCH-Q 47) | 0.17 ± 0.14 (-0.10, 0.44) | -0.04 ± 0.12 (-0.27, 0.20) | -0.21 ± 0.13 (-0.47, 0.05) | 0.11 | -0.16 |
| French fries or baked potato (CATCH-Q 50) | 0.10 ± 0.10 (-0.11, 0.30) | -0.09 ± 0.08 (-0.26, 0.07) | -0.19 ± 0.12 (-0.43, 0.05) | 0.12 | -0.16 |
| **Likely to be physically active or eat certain foods** | | | | | |
| Physically active 3-5 times a week (CATCH Q 52) | -0.26 ± 0.15 (-0.56, 0.04) | 0.21 ± 0.12 (-0.02, 0.44) | 0.47 ± 0.19 (0.09, 0.85) | 0.02 | 0.25 |
| Exercise and keep moving for most of the time in your after-school program? (CATCH Q 53) | -0.03 ± 0.23 (-0.48, 0.43) | -0.03 ± 0.2 (-0.42, 0.37) | 0.00 ± 0.22 (-0.45, 0.45) | 0.99 | 0 |
| Run or bike 3-5 times a week? (CATCH Q 54) | -0.18 ± 0.19 (-0.56, 0.19) | 0.11 ± 0.15 (-0.18, 0.41) | 0.30 ± 0.23 (-0.17, 0.76) | 0.21 | 0.13 |

| | | | | | |
|---|---|---|---|---|---|
| Keep up a steady pace without stopping for 15-20 minutes when you are physically active? (CATCH Q 55) | 0.05 ± 0.18 (-0.3, 0.4) | -0.04 ± 0.13 (-0.31, 0.23) | -0.09 ± 0.22 (-0.53, 0.35) | 0.69 | -0.04 |

Results are expressed as Estimate ± Standard Error (95% confidence interval).
*Effect Sizes

Results of physical activity behavior are presented in Table 4. Only a significant effect (P=0.02) was demonstrated with the behavior, "being physically active 3-5 times a week." Other physical activity behaviors were marginally significant and ranged from (P=0.21 to 0.99). Interactions of change values of BMI, BMI z-scores, and responses from the ASSQ measures by gender are shown in **Table 5**. Significant interactions include male responses to questions regarding "previous day sports activity participation" and "label reading." There were disparities in sample sizes of comparison and intervention groups; however, the validity of statistical analysis was not affected.

**Table 5:** Interactions of BMI, BMI-Z-Scores and Responses to Selected ASSQ Questions by Gender of Comparison and Intervention Groups

| Variable | Group | | | | |
|---|---|---|---|---|---|
| | Comparison | Intervention | Difference | P | ES* |
| | | **BMI** | | | |
| Male | 0.46 ± 0.43 (-0.40, 1.33) | 0.58 ± 0.37 (-0.18, 1.34) | 0.12 ± 0.36 (-0.61, 0.85) | 0.75 | 0.05 |
| Female | 0.19 ± 0.68 (-1.19, 1.57) | 0.41 ± 0.68 (-0.98, 1.8) | 0.22 ± 0.51 (-0.80, 1.25) | 0.66 | 0.07 |
| | | **BMI-z-scores** | | | |
| Male | 0.38 ± 0.20 (-0.02, 0.77) | 0.12 ± 0.18 (-0.24, 0.49) | -0.25 ± 0.15 (-0.56, 0.05) | 0.10 | -0.25 |
| Female | 0.09 ± 0.32 (-0.55, 0.73) | 0.35 ± 0.29 (-0.23, 0.93) | 0.26 ± 0.32 (-0.38, 0.90) | 0.41 | 0.13 |
| | | **BMI-z-scores** | | | |
| | | **5th to 85th percentile** | | | |
| Male | 0.54 ± 0.25 (0.03, 1.05) | 0.17 ± 0.23 (-0.31, 0.66) | -0.37 ± 0.14 (-0.66, -0.07) | 0.02 | -0.5 |
| Female | 0.21 ± 0.26 (-0.33, 0.74) | 0.22 ± 0.24 (-0.28, 0.73) | 0.02 ± 0.11 (-0.22, 0.25) | 0.87 | 0.03 |
| | | **85th to >95th percentile** | | | |
| Male | . | -0.01 ± 0.02 (-0.11, 0.09) | . | . | . |
| Female | . | . | . | . | . |
| | | **>95th percentile** | | | |
| Male | -0.06 ± 0.05 (-0.19, 0.07) | 0.05 ± 0.02 (0.00, 0.09) | 0.10 ± 0.06 (-0.04, 0.24) | 0.12 | 0.58 |
| Female | -0.07 ± 0.04 (-0.17, 0.03) | 0.02 ± 0.02 (-0.03, 0.08) | 0.09 ± 0.05 (-0.02, 0.2) | 0.09 | 0.66 |
| | | **CATCH Kids Club After-School Questionnaire (CATCH-Q 11) Sports Activity** | | | |
| Male | 0.40 ± 0.16 (0.07, 0.73) | -0.18 ± 0.11 (-0.39, 0.04) | -0.58 ± 0.19 (-0.97, -0.18) | 0.01 | -0.42 |
| Female | -0.05 ± 0.14 (-0.33, 0.23) | 0.15 ± 0.12 (-0.10, 0.39) | 0.20 ± 0.18 (-0.17, 0.57) | 0.29 | 0.15 |
| | | **(CATCH-Q 18) Label Reading** | | | |
| Male | 0.53 ± 0.28 (-0.04, 1.11) | -0.29 ± 0.19 (-0.67, 0.09) | -0.83 ± 0.34 (-1.52, -0.14) | 0.02 | -0.35 |
| Female | -0.05 ± 0.23 (-0.52, 0.42) | 0.19 ± 0.20 (-0.22, 0.60) | 0.24 ± 0.30 (-0.37, 0.85) | 0.43 | 0.12 |
| | | **(CATCH-Q 21) Eat High Fiber Cereal** | | | |
| Male | 0.34 ± 0.31 (-0.29, 0.96) | -0.09 ± 0.23 (-0.55, 0.36) | -0.43 ± 0.33 (-1.09, 0.23) | 0.20 | -0.19 |
| Female | -0.13 ± 0.28 (-0.69, 0.42) | 0.34 ± 0.26 (-0.18, 0.87) | 0.48 ± 0.28 (-0.09, 1.05) | 0.1 | 0.25 |

Results are expressed as Estimate ± Standard Error (95% confidence interval).
*Effect Sizes

## DISCUSSION

Studies that examined strategies for preventing childhood obesity in African American children are sparse. The Spark Plus Afterschool Program is a novel intervention which combines engaging nutrition education classes and exciting physical activities for the purpose of improving healthy weight-related behaviors in under-resourced African American children. This pragmatic trial demonstrated feasibility and was well received by the participants. Children readily tasted new food items and prepared healthy snacks. Brightly colored balls, hoops, paddles, etc. initiated excitement in the children and the desire to participate in longer periods of physical activities. Children in the intervention group showed an increase in total HEI scores and intent to pursue healthy eating. Although total HEI scores improved, they remained below 50 points. This is possibly a reflection of families' socioeconomic backgrounds and limited access to healthy foods.

There were mixed results relative to nutrition and physical activity knowledge, behaviors, and BMI z-scores between the intervention and comparison group. A healthy weight for children lies between the 5$^{th}$ and 84$^{th}$ percentiles on the BMI scale. At baseline, 32% of children in comparison group and 38% in intervention group had weights >85$^{th}$ percentile for age and sex, respectively. At post intervention, 28% of children in comparison group and 42% of children in the intervention group had weights >85$^{th}$ percentile for age and sex. Intervention children showed an increase in BMI-z-scores >85$^{th}$ percentile for age and sex, post-intervention may indicate a need for an increased in intensity and/or duration of physical activities. Children displayed a high level of enthusiasm and excitement engaging in the sports and hands-on activities.

The main strength of the study is its design that incorporated nutrition education and physical activities into a setting where children freely negotiated. Important data were obtained that would be useful in designing large, randomized controlled trials. Other strengths included the use of a theoretical framework, a broad set of intervention strategies, strong partnerships with community stakeholders, and the implementation process under pragmatic conditions.

Afterschool programs offer tremendous opportunities to provide health promotion activities to supplement the traditional school day which is limited due to the curriculum and instructional demands. Through local school districts' wellness policy requirement, afterschool programs can build on their existing relationships with students, schools, parents, and the community to advance a holistic approach to childhood obesity prevention [34,35].

## LIMITATIONS

There were several limitations of the trial, including impromptu ASP schedule changes, accuracy of children's self-reported behaviors, limited follow-up assessments, and parental participation. Logistics issues related to the use of physical activity monitors prevented objective assessment of physical activity. Further limitation is a lack of a priori data to conduct a power analysis. This may suggest that non-significant findings may be reported due to lack of power, but significant findings validate relevant inferences. Results of this study support our hypothesis that the SPARK PLUS program could be beneficial if replicated on a large scale in the future. Evaluating novel strategies for motivating parental involvement in after-school childhood obesity prevention programs is an important research focus.

## CONCLUSION

Afterschool programs can provide realistic venues where health and wellness of under-resourced children are improved by promoting healthy eating and physical activity habits. With close collaboration between ASP staff and nutrition educators, it is possible to integrate an effective childhood obesity prevention component into the normal schedule of afterschool programs Evidence produced by this trial can be used to inform ASP policy leaders and educators, community and funding organizations, parents, and health education researchers regarding the efficacy and benefits of including structured nutrition education and physical activity programs in communities ASPs serve.

## ACKNOWLEDGEMENTS

Research reported in this publication was supported by funding from the United Department of Agriculture, Agricultural Research Service [3092-51000-056-04A].

The authors gratefully acknowledge the cooperation and support of the staff and students of the after-school programs for participation in the SPARK PLUS After-School Intervention.

## HUMAN SUBJECT APPROVAL STATEMENT

The Institutional Review Board of Southern University and A&M College approved this study and all participants provided written informed consent.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

1. Prevalence of childhood obesity in the United States. Childhood obesity facts.
2. Daniels SR (2006) The consequences of childhood overweight and obesity. Future Child. Spring 16(1); 47-67.
3. Sahoo K, Sahoo B, Kumar A, Choudhury AK, Sofi NY, et al. (2015) Childhood obesity: Causes and consequences. J Family Med Prim Care 4(2); 187-92.
4. Robert Wood Johnson Foundation (2021) State of childhood obesity: Helping all children grow up healthy.
5. Arteaga SS, Esposito L, Osganian SK, Pratt CA, Reedy J, et al. (2018) Childhood obesity research at the NIH: Efforts, gaps, and opportunities. Transl Behav Med 8(6); 962-967.
6. Kumanyika SK, Whitt-Glover MC, Haire-Joshu D (2014) What works for obesity prevention and treatment in black Americans? Research directives. Obes Rev 15(4); 204-212.
7. Yamashiro N, Rinehart J (2014) America after 3 PM: Afterschool programs in demand. Afterschool Alliance.
8. Afterschool Alliance (2017) Making the afterschool hours active hours: The afterschool alliance obesity prevention agenda.

9. Healthy Out-of-School Time Coalition (2019) National Afterschool Association HEPA (Healthy Eating and Physical Activity)

10. Afterschool Alliance (2022) Promoting healthy futures: Afterschool provides the supports parents want for children's well-being.

11. Gortmaker SL, Lee RM, Mozaffarian RS, Sobol AM, Nelson TF, et al. (2012) Effect of an after-school intervention on increases in children's physical activity. Med Sci Sports Exer 44(3); 450-457.

12. Schuna JrJM, Lauersdorf RL, Behrens TK, Liguori G, Liebert ML (2013) An objective assessment of children's physical activity during the Keep It Moving! after-school program. J Sch Health 83(2); 105-111.

13. Gatto N, Martinez L, Spruijt-Metz D, Davis J (2017) LA Sprouts randomized controlled nutrition, cooking and gardening programme reduces obesity and metabolic risk in Hispanic/Latino youth. Pedia Obes 12(1); 28-37.

14. McCall SC (2016) Preparing healthy snacks with third graders to improve knowledge of nutrition. J South Carolina Acad Sci 14(2); 37-40.

15. Messiah SE, Vidot D, Hansen E, Kardys J, Matthew SM, et al. (2017) Impact of a park-based afterschool program replicated over five years on modifiable cardiovascular disease risk factors. Prev Med 9566-73.

16. Ling J, Robbins LB, McCarthy VL, Speck BJ (2015) Psychosocial determinants of physical activity in children attending afterschool programs. Nurs Res 64(3); 190-199.

17. Kelder S, Hoelscher DM, Barosso CS, Walker JL, Cribb P, et al. (2004) The CATCH Kids Club: A pilot after-school study for improving elementary students' nutrition and physical activity. Pub Heal Nut 8(2); 133–140.

18. Hastmann TJ, Bopp M, Fallon EA, Rosenkranz RR, Dzewaltowski DA (2012) Factors influencing the implementation of organized physical activity and fruit and vegetable snacks in the HOP'N after-school obesity prevention program. J Nutr Educ Behav 45(1); 60-68.

19. Beets MW, Weaver RG, Turner-McGrievy G, Huberty J, Ward DS, et al. (2014) Making healthy eating and physical activity policy practice: The design and overview of a group randomized controlled trial in afterschool programs. Contemp Clin Trials 38(2); 291-303.

20. Nabors L, Burbage M, Woodson KD, Swoboda C (2015) Implementation of an after-school obesity prevention program: Helping young children toward improved health. Comprehensive Pediatric Nursing 38(1); 22-38.

21. Brown T, Moore TH, Hooper L, Gao Y, Zayegh A, et al. (2019) Interventions for preventing obesity in children. The Cochrane database of systematic reviews 7(7); CD001871.

22. Branscum P, Manoj S (2012) After-school based obesity prevention interventions: A comprehensive review of the literature. Int J Environ Res Pub Heal 9; 1438-1457

23. Bandura A (1986) Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

24. Rolling T, Hong M (2016) The effect of social cognitive theory based interventions on dietary behavior within children. J Nutri Health Food Sci 4(5); 1-9.

25. Healthy Eating Index 2015.

26. CATCH Kids Club After-School Student Questionnaire.

27. Center for Disease Control and Prevention.

28. Kelder S, Hoelscher DM, Barosso CS, Walker JL, Cribb P, et al. (2004) The CATCH Kids Club: A pilot after-school study for improving elementary students' nutrition and physical activity. Public Health Nutrition 8(2); 133–140.

29. Government of District of Columbia (2018) 2017 Nutrition Curriculum Review: A Guidance Document for K-12.

30. SPARK After-School Program.

31. Principles of Parenting: The Challenge of Being a Parent.

32. Money Sense for Your Children.

33. SAS Institute.

34. Afterschool Alliance (2022) Afterschool & Health: Opportunities for Advocacy.

35. National Conference of State Legislators (2022) Supporting Student Success Through Afterschool Programs.