Summer 2007

Effectiveness of the Spark Program in Increasing Fitness among Children and Adolescents

Latrice Stephanie Sales
Georgia Southern University

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THE EFFECTIVENESS OF THE SPARK PROGRAM IN INCREASING FITNESS AMONG CHILDREN AND ADOLESCENTS

by

LATRICE S. SALES

(Under the Direction of Jim McMillan)

ABSTRACT

The present study evaluated the effectiveness of the SPARK program in increasing cardiovascular and musculoskeletal fitness among children and adolescents. It was hypothesized that participation in the SPARK program would significantly increase fitness as measured by the FITNESSGRAM physical fitness battery. 247 children age 7 – 12 at the Boys and Girls Club of Bulloch County, Inc. were placed in either a treatment group that received the SPARK program twice a week or a control group that went to a study hall. Fitness assessments were performed before and after the 6-week physical activity program. Results indicated a significant increase in measures of flexibility and upper body muscular strength and endurance. Statistical significance was not found for measures of aerobic capacity, lower-body muscular strength and endurance, and body-mass-index (BMI). However meaningful changes in BMI percentiles were found, indicating a decline in risk classification with physical activity, independent of increases in fitness.

INDEX WORDS: Physical activity, Fitness, SPARK, Children, Adolescents, FITNESSGRAM
THE EFFECTIVENESS OF THE SPARK PROGRAM IN INCREASING FITNESS
AMONG CHILDREN AND ADOLESCENTS

by

LATRICE S. SALES
B.S., Coastal Carolina University, 2004

A Thesis Submitted to the Graduate Faculty of Georgia Southern University in Partial
Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

STATESBORO, GA
2007
THE EFFECTIVENESS OF THE SPARK PROGRAM IN INCREASING FITNESS
AMONG CHILDREN AND ADOLESCENTS

by

LATRICE S. SALES

Major Professor: Jim McMillan

Committee: Starla McCollum
Jonathan Metzler
Drew Zwald

Electronic Version Approved:
July 2007
DEDICATION

This thesis is dedicated to my sister Natalie who always believed in me. Her encouragement kept me afloat when I thought I was drowning. I probably would not have gotten through this (on time) without her unwavering love and support.

This thesis is also dedicated to great friends: Chaja, Darius, Meg, Brandon, LaToya, Jocelyn, TK, and Tedrick.
ACKNOWLEDGEMENTS

I want to thank everyone who helped me with this project, particularly my thesis committee and the staff at the Boys & Girls Club of Bulloch County, Inc. I want to especially thank Dr. McMillan for being so thorough. Thank you for your guidance and dedication to this project. Thank you to Dr. Zwald for providing me with the opportunity to do this project.

I also want to acknowledge the GSU students and volunteers who helped with this project, namely, Kyla Clark, Stephen Johnson, Ashley Parker and Jimmy Gleissner. Thank you for stepping up and being leaders. Your hard work was greatly appreciated.
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CHAPTER 1
INTRODUCTION

The prevalence of childhood overweight and obesity in the United States has reached epidemic proportions. Results from the 2003-2004 National Health and Nutrition Examination Survey (NHANES), using measured heights and weights, indicate that an estimated 17% of children and adolescents ages 2-19 years are overweight (CDC “Overweight prevalence,” 2006). The overweight and obesity trend in Georgia is even more alarming: fifty-nine percent of adults in Georgia are overweight or obese; 26% of Georgia high-school students, 33% of middle school students, and 27% of low-income children between 2 and 5 years of age are overweight or at risk of becoming overweight (CDC “State-based programs,” 2006). The primary causative factors for overweight and obesity among children and adolescents are unhealthy dietary behaviors and a sedentary lifestyle (CDC “Overweight prevalence,” 2006). Since dietary and sedentary habits formed during childhood are likely persist into adulthood, intervention strategies are most effective when started in the formative years of life (CDC “Overweight prevalence,” 2006). Intervention is needed that focuses on increasing awareness and knowledge of the benefits of regular physical activity and developing the life skills necessary to maintain a healthy lifestyle. Focus should not only be placed on increasing physical activity, but also improving physical fitness. Recent studies show that in adults with type II diabetes, a concomitant change in body weight and an improvement aerobic capacity improves insulin sensitivity and metabolic flexibility more than weight loss alone (Kelley, 2005; Conroy, Manson, Buring & Lee, 2005; Peters, 2005).
The U.S. Surgeon General asserts that behavior and environment play a large role in contributing to the overweight and obesity epidemic (CDC “Contributing factors,” 2006). Children are spending less time engaging in physical activity at home and at school. A major factor contributing to the decline in daily physical activity among children has been the reduction in school-based physical education (PE) and physical activity (PA) programs. In an effort to improve academic performance, administrators are cutting PE classes and free time that could be spent engaging in physical activity. The Georgia House Bill 1187, passed in 2000, amended state-mandated PE requirements and made PE classes optional for middle schools in Georgia. The Georgia State Board of Education has by rule made PE and Health mandatory for grades K-5 for 90 hours of instruction per year. This means, for grades 6-12 required PE classes are at the discretion of local School Boards (Barbeau, 2005; Georgia Department of Education [GADOE], 2001). One unit of Health and PE is still required to fulfill high school graduation requirements.

Children are also spending more time engaging in sedentary behaviors, including computer activities, watching television and playing video games. A study reported by the CDC revealed that time spent watching television, videos, DVDs, and movies averaged slightly over 3 hours per day among children aged 8–18 years (CDC “Contributing factors,” 2006). Other factors contributing to the epidemic include lack of after-school programs offered by community agencies such as YMCAs and Boys & Girls Clubs, perception that neighborhoods are unsafe for outside play, low socioeconomic status and lack of access to affordable healthy food choices (CDC “Contributing factors,” 2006; Barbeau, 2005).
Many school-based physical activity interventions exist to prevent and treat childhood obesity. Most of the programs aim to increase the amount or intensity of PA, increase knowledge and awareness of healthy PA behaviors, or targeted PA outside of school (Barbeau, 2005). However, few of the interventions take into account the initial body fatness or BMI of the participants and few measured changes in cardiovascular and/or musculoskeletal fitness over time (Barbeau, 2005).

The Sport, Play and Active Recreation for Kids (SPARK) program is a comprehensive school-based health promotion intervention. SPARK was initiated in 1989 by a team of researchers and educators from San Diego State as a counter to heart disease. Because this condition can begin in childhood, the researchers and educators at San Diego State University were given a 5-year grant from the National Institutes of Health (NIH) to develop, implement, and experimentally evaluate a comprehensive health-related PE program for elementary schools (SPARK, 2006). Since the original study, SPARK has evolved into a non-profit organization dedicated to improving the quantity and quality of PA for young people. Numerous research studies provide support for the SPARK curriculum for cardiovascular health promotion and obesity risk reduction (Sallis et al., 1997; Hayman et al., 2004; Caballero et al., 2003). More precisely, studies have shown a significant positive change in levels of physical activity during and beyond school-sponsored programs, fat intake, and in food- and health-related knowledge and behaviors (Sallis et al., 1997; Hayman et al., 2004; Caballero et al., 2003). Research focusing on the efficacy of the SPARK program to improve cardiovascular and musculoskeletal fitness is limited. Therefore, the purpose of this study was to determine
the effectiveness of the SPARK program in improving cardiovascular and musculoskeletal fitness among children and adolescents.
CHAPTER 2

METHODS

Participants

The study was conducted at the Boys & Girls Club of Bulloch County, Inc. Participants included students attending the Boys & Girls Club in Statesboro, Georgia. The Club serves approximately 500 youth ranging from 7 to 14 years old from various schools in Bulloch County, Georgia. Participants were recruited via announcements and flyers sent home to the parents. As a service to the community, the research project provided daily physical fitness and nutrition education via the SPARK program. However, participation in any of the assessments was voluntary. Participants were informed of the potential risks and benefits of participating in the study. Participants under 18 years old took a letter home to their parents describing the nature of the study and were required to return a signed parental consent form to participate in the study (See Appendix L - M). Participants were also required to sign a minor’s assent form (See Appendix N).

A subsample comprised of students who are members of the 21st Century Community Learning Center (CCLC), a smaller group within the Club, were used as controls for the study. This group’s attendance and new membership fluctuated throughout the school year; therefore, they could not be used as a part of the treatment group and served as controls. The students in this subsample were representative of the Club’s population. The study was a part of the daily curriculum at the Club; however, the researchers highlighted the voluntary nature of engaging in the research aspect of the program. The researchers emphasized to all participants their inherent right to privacy.
and at any time the right to discontinue involvement in the research project (i.e., providing data).

Instrumentation

_Sports, Play, and Active Recreation (SPARK)_

The SPARK program was a comprehensive school-based health promotion intervention. The physical education initiative began in 1989 to combat the increasing obesity epidemic (Rosengard, Short, McKenzie & Strellow, 2000). While overweight and obesity have risen over the past 25 years, the minutes children spend in PE has decreased. SPARK was designed to maximize class activity time, without sacrificing learning. The focus of SPARK was the development of healthy lifestyles, motor skills and movement knowledge, and social and personal skills (Rosengard et al., 2000). The program also emphasized the importance of good nutrition and the development of lifelong healthy habits. SPARK educators and researchers aimed to accomplish their goals by disseminating services and materials to schools and youth agencies throughout the world (Rosengard et al., 2000). In addition to the original SPARK elementary PE program, SPARK has since produced six curricula: SPARK Physical Education for grades K-2, SPARK Physical Education for grades 3-6, SPARK Self-Management Level 1 (for fourth or fifth graders), SPARK Self-Management Level 2 (for fifth or sixth grade students), SPARK Multicultural Dance (for youth ages 5 through teen), and SPARK Active Recreation (for ages 5 - 14) (Rosengard et al., 2000). The current study used the SPARK Active Recreation (AR) curriculum.
**SPARK Active Recreation (AR)**

SPARK AR was designed to supplement PE classes and provide a research-based, field-tested approach for all non-PE physical activity providers (i.e. after school, YMCAs, Boys and Girls Clubs, Recreation Centers, Day Care Centers, or camps) (Rosengard et al., 2000). The AR program began in 1996 through grant collaboration with the University of Tennessee, Memphis. The AR program promoted quality, daily physical activity for youth by emphasizing health-related fitness activities (Rosengard et al., 2000). SPARK AR sessions were designed to be at least 15 minutes long, not including warm-up and cool-down (Rosengard et al., 2000). The SPARK AR curriculum included a comprehensive binder of activities containing over 450 pages of Great Games: cooperative, team building and aerobic; Dynamic Dances: line, square, multi-cultural; and Super Sports: Frisbee, hockey, volleyball and many more physical fitness activities and games (SPARK, 2006; Rosengard et al, 2000). The SPARK program also offered useful management tools and strategies for successful implementation of the program from inclusion of alternate activities, organizing and ordering equipment to management strategies for limited space, large class sizes and multiple grade levels (SPARK, 2006). The current study chose SPARK AR activities that promoted physical fitness. Activities were chosen based on principles of specificity, overload and progression in order to facilitate an increase in aerobic capacity, muscular strength, endurance and flexibility (See Appendix F).

**FITNESSGRAM**

**FITNESSGRAM** (Cooper Institute, Dallas, Texas) is a national fitness battery for youth. The assessment includes a variety of health-related physical fitness tests designed
to assess cardiovascular fitness, muscle strength, muscular endurance, flexibility, and body composition. The **FITNESSGRAM** recommended the PACER test or one-mile walk/run test to assess cardiovascular fitness. The current study used the PACER test. Muscular strength and endurance was assessed via the curl-up and 90-degree push-up tests. Flexibility was measured using the trunk lift test and the Back-Saver Sit and Reach test (BSAR). Body composition was estimated using body mass index (BMI) (Plowman, 2001). Fitness results were then entered into a computerized reporting system and compared to criterion-referenced fitness standards for youth (FITNESSGRAM, Cooper Institute, Dallas, TX). These standards were age and gender specific and were based on how fit children need to be for good health (Meredith & Welk, 2005). The program allowed teachers and healthcare professionals to produce individualized and group reports. The reports provided feedback based on whether the child achieved the criterion-referenced standards. The primary goal of **FITNESSGRAM** was to promote regular physical activity among all youth. Its purpose was to facilitate learning about physical activity and physical fitness concepts while increasing the likelihood that individuals would adopt lifetime patterns of physical activity (Welk, Morrow, & Falls, 2001).

**PACER**

The PACER was a multistage test adapted from the 20-meter shuttle run test published by Leger and Lambert (1982) and revised in 1988 (Cureton & Plowman, 2001). The test involved running back and forth across a 20-meter course in time to music played from a CD. Beeps on the soundtrack indicated when a person should reach the ends of the course. The test began at a slow pace, and each minute the pace increased. The participant continued running until the pace could no longer be maintained.
Participants were allowed one chance to miss an end of the course. When an individual did not make it to the other side before the beep a second time, their test was terminated. The PACER was similar to a graded exercise test on the treadmill in which the treadmill speed increased at regular intervals. The longer a person continued, the higher the rate of estimated oxygen uptake. In the FITNESSGRAM software, VO$_2$max was predicted from a regression equation developed by Leger et al. (1988) using age and the highest speed attained on the test (Meredith & Welk, 2005; Cureton & Plowman, 2001). The PACER was a fun alternative to distance run tests, and was recommended for children, adolescents and young adults (Cureton & Plowman, 2001).

*Curl-up Test*

The curl-up test was a cadence-based test in which participants performed curl-ups at a rate of 20 repetitions per minute. The use of a cadence with the curl-up was found to eliminate many of the concerns about the ballistic nature of one-minute all-out speed tests (Plowman, 2001; Jetté, Sidney & Cicutti, 1984). Before the test, participants were instructed to lie on the ground with both feet flat on the ground and their arms placed by their side. Participants were then instructed to curl their shoulders off the ground while reaching their arms forward toward a target line or strip of cardboard placed in front of them (See Appendix C). The action was repeated to the on the CD until the participant could no longer perform a complete repetition (Cureton & Plowman, 2001; Plowman, 2001).

*90° Push-up Test*

FITNESSGRAM recommended the 90° push-up test for measuring upper body musculoskeletal strength and endurance (Corbin & Pangrazi, 2001). The test was set to a
cadence of one push-up every three seconds played on a CD. Participants started the test in the plank or push up position - with the hands and toes touching the floor, the body and legs are in a straight line, feet slightly apart, and the arms at shoulder width apart, extended and at right angles to the body. The participant kept their back and knees straight and lowered their body until there was a 90-degree angle at the elbows, with the upper arms parallel to the floor. A partner held their hand at the point of the 90-degree angle so that the person being tested went down only until their shoulder touched their partner's hand, then back up (See Appendix D). The participant continued until they could no longer keep up with the cadence or had not done the last two in cadence (Cureton & Plowman, 2001; Corbin & Pangrazi, 2001).

*Back-Saver Sit-and-Reach (BSAR)*

The Sit-and-Reach (SAR) test was used to measure flexibility of the low back and posterior thigh, and has been applied to all age groups. Nearly all health-related fitness-testing batteries have used the SAR as a measure of flexibility. The Back-Saver SAR (BSAR) was developed to protect the low back by avoiding excessive lumbar flexion (Hartman & Looney, 2003). The rationale for the BSAR is based on the work of Calliet (1988) who suggested that stretching one hamstring at a time, instead of both at once, results in less stress and risk of injury for the low back and spine (Jones, Rikli, Max & Noffal, 1998). The BSAR was very similar to the traditional SAR except that the measurement is performed on one side at a time. To perform the test, the participant removed his or her shoes and sat down at the SAR box. The participant extended one leg fully with the foot flat against the face of the box. The other knee was bent with the sole of the foot flat on the floor. The instep was placed in line with, and two to three inches to
the side of, the straightened knee. The arms were extended forward over the measuring scale with the hands placed one on top of the other. With palms down, the student reached directly forward (keeping back straight and the head up) with both hands along the scale four times and held the position of the fourth reach for at least one second (See Appendix E) (Meredith & Welk, 2005). After one side was measured the participant switched the position of the legs and reached again. The participants were instructed that they could allow the bent knee to move to the side as the body moved forward if necessary, but the sole of the foot must remain on the floor. The number of inches on each side was recorded to the nearest ½ inch, to a maximum score of 12 inches (Meredith & Welk, 2005).

*Trunk Lift*

The trunk lift test was a measure of trunk extensor strength and flexibility. Musculoskeletal fitness of the abdominal muscles, hamstrings, and back extensors works in concert to maintain low back health (Meredith & Welk, 2005). The objective of the trunk lift test was to lift the upper body off the floor using the muscles of the back and hold the position to allow for the measurement. The participant began testing by lying facedown on a mat with their toes pointed and hands placed under the thighs. A coin or marker was placed on the floor in line with the student’s eyes. During the movement, the student’s focus did not move from the coin or marker. The student then lifted the upper body off the floor in a very slow and controlled manner. The score was recorded by placing a ruler on the floor an inch to the front of the participant’s chin. The participant was allowed two trials and the highest score was recorded with a maximum height of 12 inches (Meredith & Welk, 2005).
**BMI**

Body mass index (BMI) provided an indication of the appropriateness of a child’s weight relative to height (Meredith & Welk, 2005). BMI was expressed as the student’s weight in kilograms divided by squared height in meters. The present study used the English formula: \[ \text{BMI} = \frac{\text{Weight in pounds}}{\text{Height in inches}^2} \times 703 \]. Participants removed their shoes and outer layers of clothing (i.e. jackets and bulky sweaters) in order to obtain a more accurate height and weight. Measurements were then recorded to the nearest whole number (Meredith & Welk, 2005). After calculating BMI, the BMI number was then plotted on the CDC BMI-for-age percentile charts (for either girls or boys) to obtain a percentile ranking (See Appendix G – H). The Centers for Disease Control and Prevention (CDC) supported percentile rankings as the most commonly used indicator to assess the size and growth patterns of individual children in the United States (CDC “About BMI,” 2006). The percentile indicated the relative position of the child’s BMI among children of the same sex and age (CDC “About BMI,” 2006). The growth charts also displayed weight status categories used with children and teens: underweight, healthy weight, at risk of overweight, and overweight (CDC “About BMI,” 2006). Because the amount of body fat changed with age and differed between girls and boys, the CDC BMI-for-age percentile charts were created to account for these differences and allowed translation of a BMI number into a percentile ranking for the child’s gender and age (CDC “About BMI,” 2006).
Procedures

Participants were recruited via announcements at the BGC and flyers sent home to their parents (See Appendix L). Parents who allowed their child to participate were required to review and sign a parental consent form. After parental consent was granted, participants 18 years old or younger were also required to review and sign a minor’s assent form. All students received daily PA instruction; while those who agreed to participate in the study were asked to complete a pre and post physical fitness assessment via the *FITNESSGRAM*. After the initial assessments were, the researchers implemented the SPARK curriculum for six weeks to the treatment group. Initial assessments included anthropometric data such as name, age, height and weight, and the *FITNESSGRAM* assessments. The control group resumed their regularly scheduled activities at the BGC. After six weeks of instruction, participants were asked to complete a post physical fitness assessment. Participants attended two 1-hour PA sessions each week. PA sessions included were designed to keep the participants active for a minimum of thirty minutes per session. Activities included SPARK AR lessons including aerobic games, cooperative games, fitness circuits, and dynamic dance (See Appendix F). Students were led through a warm-up and cool-down before and after each PA session, respectively. The purpose of the warm-up was to prepare the muscles, joints, and heart for activity while also helping to reduce injury and improve motor skill performance (Rosengard et al., 2000). The cool-down helped to return the children’s bodies to normal functioning while improving joint flexibility when muscles were warm. The warm-up and cool-down periods also provided instructors the opportunity to establish and review instructional
cues and strategies. The specifics of each SPARK AR session are outlined in Appendix F and are thoroughly detailed in the SPARK AR curriculum binder (Rosengard et al., 2000).

After the final assessments, the control group was given the opportunity to participate in the SPARK program for the remainder of the school term. Also, the control group will receive the benefit of the program during the summer sessions. Research personnel were trained how to administer all physical fitness assessments as well as how to effectively teach the SPARK AR curriculum. Research personnel included Georgia Southern University kinesiology, health and physical education graduate and undergraduate students. All personnel received a 3-hour training course which outlined the methods, policies and procedures pertaining to the research study; including curriculum advancement, IRB guidelines, and discipline and safety procedures. Throughout the program, physical activity instructors were monitored and evaluated to ensure compliance and quality instruction. The instructors were required to complete an assignment that demonstrated their knowledge of the SPARK AR curriculum. The instructors were also required to submit a weekly PA evaluation that identified program competencies and limitations.
CHAPTER 3

RESULTS

The study consisted of 247 children aged 7 – 12 (121 boys and 126 girls) at the Boys & Girls Club of Bulloch County, Inc., Statesboro, GA. Students included 80 third graders (32.4%), 91 fourth graders (36.8%), and 76 fifth graders (30.8%). Ninety-three children comprised the treatment group (37.8%) while 153 children were included in the control group (62.2%). Mean age for the both the treatment and control group was 10 years (9.72 ± 1.1 and 9.9 ± 1.1, respectively). Although the study included 247 children, experimental mortality limited results to those who provided data at both pre and post fitness assessments. Mortality was random and mainly due to absences and voluntary refusal to participate. Attendance was taken before each physical activity session and students who did not participate in at least 75% of the activity sessions were removed from the treatment group. Therefore, results differed depending on the number of students who participated in both assessments of each fitness test. FITNESSGRAM physical fitness tests were measured at baseline and again after the 6-week program. Mean values for each physical fitness test are displayed by group in Table 1 and 2. SAR values are an average of the two legs. BMI was calculated using the English formula [Weight in Pounds / (Height in inches)^2 x 703]. BMI values were then charted on the CDC BMI-for-age-and gender percentile chart (See Appendix G - H).

Statistical analyses were carried out using SPSS statistical software (Version 14.0, SPSS Inc., Chicago, Illinois). Data were reported as means ± standard deviations. ANOVA for repeated measures was used to determine the effect of the SPARK program on cardiovascular and musculoskeletal fitness between the two groups.
Table 1. Mean Values: Treatment Group

<table>
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<th>Pretest</th>
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<th>Posttest</th>
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<td>Mean</td>
<td>Std.</td>
<td>Mean</td>
<td>Std.</td>
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<tr>
<td>Pacer (# of laps)</td>
<td>43</td>
<td>16.16</td>
<td>9.6836</td>
<td>16.49</td>
<td>11.08</td>
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<td>Trunk Lift (in)</td>
<td>50</td>
<td>11.67</td>
<td>0.6437</td>
<td>11.92</td>
<td>0.34</td>
</tr>
<tr>
<td>SAR (cm)</td>
<td>39</td>
<td>25.34</td>
<td>7.4999</td>
<td>28.66</td>
<td>6.494</td>
</tr>
<tr>
<td>Push-ups</td>
<td>40</td>
<td>11.95</td>
<td>8.348</td>
<td>15.65</td>
<td>10.6</td>
</tr>
<tr>
<td>Curl-ups</td>
<td>28</td>
<td>46.07</td>
<td>26.705</td>
<td>48.68</td>
<td>28.98</td>
</tr>
<tr>
<td>BMI</td>
<td>34</td>
<td>20.65</td>
<td>4.5129</td>
<td>20.55</td>
<td>4.125</td>
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Table 2. Mean Values: Control Group

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th></th>
<th>Posttest</th>
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<th>Mean Diff.</th>
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<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>Std.</td>
<td>Mean</td>
<td>Std.</td>
</tr>
<tr>
<td>Pacer (# of laps)</td>
<td>18</td>
<td>14.56</td>
<td>9.1666</td>
<td>15.83</td>
<td>9.18</td>
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<tr>
<td>Trunk Lift (in)</td>
<td>22</td>
<td>11.59</td>
<td>0.7964</td>
<td>11.73</td>
<td>0.55</td>
</tr>
<tr>
<td>SAR (cm)</td>
<td>18</td>
<td>25.85</td>
<td>6.474</td>
<td>29.54</td>
<td>5.08</td>
</tr>
<tr>
<td>Push-ups</td>
<td>13</td>
<td>17.08</td>
<td>10.388</td>
<td>23.31</td>
<td>12.82</td>
</tr>
<tr>
<td>Curl-ups</td>
<td>5</td>
<td>40.6</td>
<td>27.79</td>
<td>58.6</td>
<td>25.47</td>
</tr>
<tr>
<td>BMI</td>
<td>14</td>
<td>20.12</td>
<td>4.8875</td>
<td>19.95</td>
<td>3.865</td>
</tr>
</tbody>
</table>

Mean differences between the pretest and posttest for each group were also described for each fitness test. An analysis of interaction effects was performed on all fitness tests to assess whether the effect of time differed as a result of the program. A level of significance of $P < 0.05$ was used for hypothesis testing. No significant interaction was found between the control group and treatment group across the two trials of the FITNESSGRAM tests, suggesting that any change over time is independent of group. However, a significant time effect was found among three of the fitness tests: SAR ($p = .001$), trunk lift test ($p = .039$) and the push-up test ($p = .007$).
Sit-and-Reach (SAR)

The SAR test is a measure of low-back and hamstring flexibility. Thirty-nine students from the treatment group and 18 students from the control group provided data for both trials. A repeated measures ANOVA revealed a main effect of time (F(1, 55) = 12.69, p = .001) but did not show an interaction between the two groups (F(1, 55) = .036, p = 0.85). Both the treatment and control groups increased their SAR score; however, the rate of increase was greater in the control group than the treatment group (mean difference of -3.4 and -6.23, respectively).

Figure 1. Sit-and-Reach Test
Trunk Lift

The trunk lift test is a measure of trunk extensor strength and flexibility. The maximum score for this test is 12 inches. Fifty students in the treatment group and 22 students in the control group provided pre and post data for the trunk lift test, which showed a significant positive change over time ($F (1, 70) = 4.41, p = .039$). However, there was no interaction between the treatment and control groups ($F (1, 70) = 0.381, p = .54$). The treatment group was more flexible than the control group (X-bar = 12 ± 0.31 and 11.6 ± 0.08, respectively). Both groups exhibited increases in flexibility over time. The treatment group showed a greater increase over time than the control group with a mean difference of -0.23 in and 0.0013, respectively.

Figure 2. Estimated Marginal Means: Trunk Lift
**90-degree Push-up Test**

The 90-degree push-up test is a measure of upper body muscular strength and endurance. Forty students from the treatment group and 13 students from the control group provided both pre- and posttest data for the push-up test. A main effect of time ($F(1, 51) = 7.96, p = .007$) was found for this test, suggesting that both groups performed significantly more push ups over time. The control group averaged more push ups over time ($X\text{-bar} = 20.2 \pm 10$) than the treatment group ($X\text{-bar} = 17 \pm 10.6$). No interaction was found between the two groups for the push up test ($F(1, 51) = .234, p = .631$).

Figure 3. 90-degree Push-up Test
PACER

The PACER test is a measure of aerobic capacity. $\text{VO}_2\text{max}$ is estimated using a regression equation including age and the highest number of laps attained on the test. Because of varying professional opinions on whether aerobic capacity can be trained in young children (see Appendix B), results compared the number of laps performed during the pre test versus the posttest. The number of students who provided pre and post data from the treatment and control groups was 43 and 18, respectively. No significant interaction ($F (1, 51) = 1.10, p = .299$) or time effect ($F (1, 59) = 0.33, p = 0.57$) was found for the PACER test. The students actually ran fewer laps in the posttest than the pretest. The treatment group averaged more laps ($X\text{-bar} = 15 \pm 10.4$) than the control group ($X\text{-bar} = 13.2 \pm 7.5$). However, the control group decreased more over time (mean difference $= 2.36$) than the treatment group (mean difference $= 0.075$).

Figure 4. PACER Test
Curl-ups

The curl-up test, like the push-up test, is a measure of muscular strength and endurance. The maximum value that can be obtained is 80 curl-ups. The number of students who provided data from the treatment and control groups was 28 and 5, respectively. No significant interaction ($F (1, 31) = 0.96, p = 0.34$) or time effect ($F (1, 31) = 1.72, p = 0.199$) was found. Posttest curl-up scores were higher than pretest scores in both groups. The treatment group performed more curl-ups over time ($X_{bar} = 48 \pm 26.4$) than the control group ($X_{bar} = 47.1 \pm 23$); however, both groups improved at approximately the same rate with a mean difference of -1.8 and -1.75, respectively.

Figure 5. Curl-up Test
BMI

BMI provides an indication of the appropriateness of a child’s weight relative to height. The number of students who provided their height and weight from the treatment and control groups was 34 and 14, respectively. No significant interaction ($F (1, 46) = 0.025, p = 0.88$) or time effect ($F (1, 46) = 0.38, p = 0.54$) was found. The treatment group had a higher BMI ($X$-bar $= 20.8 \pm 4.5$) than the control group ($X$-bar $= 20.5 \pm 3.8$), while the control group’s BMI decreased or improved more over time than the treatment group with a mean difference of 0.74 and 0.02, respectively.

Figure 6. Estimated Marginal Means: BMI
BMI-for-Age-and-Gender Percentile

The CDC recommended using the BMI-for-age-and gender percentile charts as a means analyzing BMI numbers for children. Although BMI alone was not statistically significant, the present study exhibited a meaningful change in BMI percentiles from pre to post. Students were classified into a percentile ranking based on their BMI score, age (at posttest), and gender. Percentile groups include: 10th, 25th, 50th, 75th, 85th, 90th, 95th, and 97th percentiles (CDC “About BMI,” 2006). Students who were below the 10th percentile were considered underweight (CDC “About BMI,” 2006). The 25th percentile to below the 85th percentile was considered a healthy-weight range (CDC “About BMI,” 2006). Students who were between the 85th to less than 95th percentile were considered at risk of overweight, while those in and above the 95th percentile were considered overweight (CDC “About BMI,” 2006). BMI percentiles for boys and girls are listed in tables 3 – 6 and illustrated in figures 3.7 – 3.10.

Table 3. BMI-for-age percentile: Boys pretest

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td>1</td>
<td>.8</td>
</tr>
<tr>
<td>25.0</td>
<td>4</td>
<td>3.3</td>
</tr>
<tr>
<td>50.0</td>
<td>8</td>
<td>6.6</td>
</tr>
<tr>
<td>75.0</td>
<td>10</td>
<td>8.3</td>
</tr>
<tr>
<td>90.0</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>95.0</td>
<td>2</td>
<td>1.7</td>
</tr>
<tr>
<td>97.0</td>
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<td>35.5</td>
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<tr>
<td>Total</td>
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Table 4. BMI-for-age Percentile: Boys posttest

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td>2</td>
<td>1.7</td>
</tr>
<tr>
<td>25.0</td>
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<td>50.0</td>
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<tr>
<td>75.0</td>
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<td>85.0</td>
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<td>2.5</td>
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<tr>
<td>90.0</td>
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<tr>
<td>95.0</td>
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<td>0.8</td>
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<tr>
<td>97.0</td>
<td>7</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
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<td>28.1</td>
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<tr>
<td>Missing</td>
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<td>71.9</td>
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<tr>
<td>Total</td>
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</table>

Figure 7. BMI-for-Age Percentiles: Boys Pretest
Figure 8. BMI-for-Age Percentiles: Boys Posttest

Table 5. BMI-for-age Percentile: Girls pretest

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
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<td>1.6</td>
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<tr>
<td>25.0</td>
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<td>75.0</td>
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<td>4.0</td>
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<tr>
<td>85.0</td>
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<td>4.0</td>
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<tr>
<td>90.0</td>
<td>14</td>
<td>11.1</td>
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<tr>
<td>97.0</td>
<td>18</td>
<td>14.3</td>
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<tr>
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<td>50.8</td>
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<tr>
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Table 6. BMI-for-age Percentile: Girls posttest

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<tr>
<th>Percentile</th>
<th>Frequency</th>
<th>Percent</th>
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<tbody>
<tr>
<td>25.0</td>
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<tr>
<td>50.0</td>
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<td>90.0</td>
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<td>97.0</td>
<td>7</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
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</table>

Missing System 87 69.0
Total 126 100.0

Figure 9. BMI-for-Age Percentiles: Girls Pretest
Figure 10. BMI-for-Age Percentiles: Girls Posttest
CHAPTER 4

DISCUSSION

The current study examined the effects of the SPARK program on cardiovascular and musculoskeletal fitness among children and adolescents at the Boys and Girls Club of Bulloch County, Inc. Fitness was assessed using six measures of physical fitness via the FITNESSGRAM physical fitness battery. It was hypothesized that participation in the SPARK program would significantly increase cardiovascular and musculoskeletal fitness. It was also hypothesized that non-participation would produce no significant change in fitness. A finding of the study was an increase in flexibility over time as shown by significant changes in the SAR and trunk lift tests among both groups, with the treatment group exhibiting the largest change. Another finding of the study was an increase in upper body muscular strength and endurance in both the treatment and the control group. Students increased their ability to perform the push-up test over time. The students also exhibited a change in BMI percentile rankings over time. The number of students who were in the 97\textsuperscript{th} percentile (overweight category) decreased by nearly half for both girls and boys. Conversely, the number of students in the 50\textsuperscript{th} percentile (healthy weight category) increased. The increase is likely due to movement from a higher percentile group or risk classification to a lower percentile. Although, BMI was not statistically significant, this meaningful change in percentile rankings indicates a decreased or attenuated risk classification independent of increases in fitness. The study, however, failed to produce differences in lower body muscular strength and endurance, aerobic capacity and body composition between groups over time. Moreover, an interaction was
not found between the treatment and control groups, suggesting that any change found was independent of the group in which the child participated.

The study consisted of 247 children, yet a substantially lower number of children actually completed both the pre and post assessments for each physical fitness test. Consequently, changes found or a lack thereof were considerably affected by N. For example, the study found a significant main effect of time for the push-up test, trunk lift test and SAR test. However, for each of those tests, the control group recorded higher scores than the treatment group. This leaves one to examine why the control group is exhibiting an increase in fitness over the treatment group who received the benefit of a fitness program twice a week. The first element to consider is the sample size. The push-up test, for example, had only 13 students in the control group and 40 from the treatment group. Moreover, in the curl-up test 28 students comprised the treatment group and only 5 students from the control group. Outliers or a few outstanding students may have vastly affected statistical significance in these tests.

The second element to consider is power. Prior to the study, a power analysis recommended a sample size of 105 students. Statistical power measures the test's ability to reject the null hypothesis when it is actually false (STATISTICA, 2003). Essentially, it measures the ability to make a correct decision. The purpose of power analysis and sample size estimation was to give the researcher an estimate of how large a sample was needed to enable statistical judgments that are both accurate and reliable (STATISTICA, 2003). If the sample size is too low, the study will lack the precision to provide reliable answers to the questions it is investigating; as is the case with the current study (STATISTICA, 2003). On the other hand, if sample size is too large, valuable time and
resources may be wasted, with minimal to no benefit. The estimate was important in that it tells how likely the statistical test will be to detect effects of a given size in a particular situation (STATISTICA, 2003). Although both the treatment and control group included a greater than recommended number of students, no single test reached a total number of 105. The trunk lift test incorporated the most students with a total of 77 children.

**Recommendations / Conclusion**

Experimental mortality led to the low numbers of participants. Many students were removed from the study due to noncompliance – excessive absences or failure to provide consent – or they simply chose not participate. The large numbers of students declining to participate may be an effect of group testing. In the pilot study, students were tested in a classroom setting. The students met daily with a class of their peers and rotated with this same class throughout the day and assessments were conducted within each individual classroom. The current study tested the children with their entire grade, which may have led to the children feeling uncomfortable and shy and subsequently refusing to participate in the fitness tests. The current study used the latter method, rather than that used in the pilot study, due to time constraints. It is important to note that many children thrived in the group setting and readily participated in both the activity sessions and assessments.

Students not wanting to participate in the study may have also been a result of over saturation. Students at the Boys and Girls Club are often called upon as a sample population for research studies. The children are asked to complete surveys and provide research data several times per school year. The researchers felt that this group had been desensitized and overused as a study population. It is the observation of the researcher
team that this group of students was unresponsive and averse to being tested or studied. It is recommended that future researchers planning to solicit these students as a study population take the time to foster a sincere relationship with the children to build a mutual respect and trust.

It is also recommended that the number of PA sessions be increased. The CDC and the National Association for Sports and Physical Activity (NASP) recommend that school-aged youth participate daily in 60 or more minutes of moderate to vigorous physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities (Corbin & Pangrazi, 1994; Corbin, Pangrazi, & Le Masurier., 2003;). The recommendation was based on evidence related to many different health factors such as adiposity, type-2 diabetes, cardiovascular health and fitness, bone health, metabolic syndrome, mental health, and asthma (Corbin & Pangrazi, 1994; Corbin et al., 2003; Twisk, 2001; US Department of Health & Human Services, 1996). Other important benefits of daily physical activity include academic achievement, improved self-concept, altered injury potential, fitness improvement, caloric expenditure, and promotion of normal growth and development, and learning skills that will encourage lifetime activity (Corbin & Pangrazi, 1994; Corbin et al., 2003; Twisk, 2001; US Department of Health & Human Services, 1996).

It has been generally accepted that children are very active and maintain a high-level level of fitness regardless of body weight (Conroy, Manson, Buring & Lee, 2005; Welk et al., 2001; Cureton & Plowman, 2001; Plowman, 2001; Butterfield, Angell & Lehnhard, 2007; Bryan & Solomon, 2007; Harrell et al., 1998). A child’s day consists of numerous intermittent bursts of activity; therefore, it is not unusual and somewhat
expected to find similar responses to fitness in both a treatment and control group
(Conroy et al., 2005). Moreover, the current study could not control for the history effect
caused by participation in PE classes and after-school programs other than the SPARK
program. After the physical activity sessions, the children were free to participate in
other activities at the Boys and Girls Club including basketball, soccer, track & field and
street hockey sports leagues as well as random outside play. Previous studies of the
SPARK program have identified increases in physical activity levels as a direct result of
participation in the program (Sallis et al., 1997; Hayman et al, 2004; Caballero et al.,
2003). The current study is unique in that it measured baseline fitness levels and
examined changes over time that may have been attributed to participation in the SPARK
program. Although the study was not able to show significant differences in all measures
of physical fitness, it was successful in identifying a significant change in flexibility and
upper-body muscular strength and endurance.

The study also revealed a meaningful change in disease risk classification as
demonstrated by changes in BMI percentiles. The FITNESSGRAM physical fitness
battery was designed to provide students and teachers with a baseline measure of fitness
and the ability to track subsequent changes in fitness over time. A recent study by
Butterfield, Angell, & Lehnard (2007) used the FITNESSGRAM to examine changes in
fitness performance among children in grades 4 through 8 after participation in structured
PE classes. The study found substantial gains in aerobic capacity (PACER scores), yet
only minimal gains in muscular endurance and flexibility (push-ups and curl-ups)
(Butterfield, et al., 2007). The authors concluded that participation in PE combined with
after-school sports were positively associated with higher PACER scores (41). Bryan &
Solomon (2007) also supported the notion that active children demonstrate higher levels of fitness. The authors investigated the relationship between engagement in physical activity and health-related fitness. The authors noted that students who engaged in more physical activity, regardless of type, had a greater level of cardiovascular fitness (Bryan & Solomon, 2007). The current study and others intimate that participation in a structured physical education and/or physical activity program is likely to produce various gains in fitness among children and adolescents.

Children are a delicate group to study. Significant findings or a lack there of, in the current study could have been due to error by the research team, study design, or simply due to the dubious nature of children. Even the most intricate of study designs could prove inadequate when using this group of participants. Therefore, one must conceive that their efforts have been worthwhile to the current participants, future participants, and is a credible addition to the body of literature.


A.1. Purpose / Significance

The purpose of this study was to measure the effectiveness of the Sports, Play, & Active Recreation for kids (SPARK) program in improving cardiovascular and musculoskeletal fitness among children and adolescents. Current literature has successfully established a direct relationship between physical activity and physical fitness. Many studies attest to the ability of the SPARK program to increase physical activity levels outside of school sponsored programs (Sallis et al., 1997; Hayman et al., 2004; Caballero et al., 2003). The literature has not however, established whether participation in the SPARK program can increase fitness levels. Thus, the current study aimed to provide a causal link between participation in the SPARK program and an increase in cardiovascular and musculoskeletal fitness levels.

A.2. Research questions / Hypothesis

Is the SPARK curriculum effective for improving cardiovascular and musculoskeletal fitness among adolescents (10 – 17 years old)?

- The researchers hypothesized that the SPARK program would significantly increase cardiovascular and musculoskeletal fitness.
- The researchers also hypothesized that nonparticipation in the SPARK program would produce no change in fitness over time

A.3. Limitations, Delimitations, and Assumptions

The study delimited its participants to students attending the Boys & Girls Club of Bulloch County, Inc. in Statesboro, Georgia. Therefore, the study was limited to those
within that population who provided both personal and parental consent; and those who completed both physical fitness assessments. The study used the FITNESSGRAM physical fitness battery to measure fitness. The following assumptions were been made:

a. Participants will perform assessments with maximal effort

b. All participants will receive the consistent, quality instruction

A.4. Definitions

- **Cardiovascular Fitness**
  
  - The efficiency of the heart, lungs, and vascular system in delivering oxygen to the working muscle tissues so that prolonged physical work can be maintained (Fleglal, Wei, & Ogden, 2002).

- **Exercise**
  
  - Planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness (Meeks, Heit, & Page, 2003).

- **Musculoskeletal Fitness**
  
  - The current study refers to musculoskeletal fitness as combined good health and physical development. The aim of the study was to maximize the participant’s health, strength, endurance, and flexibility relative to age, sex and body composition.

- **Obesity**
  
  - The present study defines obesity as BMI above the 85th percentile for age and gender using the CDC standard data (CDC About BMI, 2006).

- **Overweight**
The present study defines overweight as BMI equal to or greater than the 95th percentile for age and gender using the CDC standard data (CDC About BMI, 2006).

- **Physical Activity (PA)**
  - Any bodily movement produced by skeletal muscles that result in caloric expenditure. (Ehrman, Gordon, Visich & Keteyian, 2003; Meeks et al., 2003)

- **Physical Education (PE)**
  - A planned, sequential K-12 curriculum that provides cognitive content and learning experiences in a variety of activity areas including basic movement skills; physical fitness; rhythms and dance; games; team, dual and individual sports; tumbling and gymnastics; and aquatics (Meeks et al., 2003).
    - Also called *physical training (PT)* or *gym*, PE is a course in which the curriculum utilizes learning in the cognitive, affective and psychomotor domains in a play or movement exploration setting (Wikipedia, 2007).

- **Physical Fitness**
  - The ability to perform physical activity and to meet the demands of daily living while being energetic and alert (comprehensive school health book).
  - Set of attributes that people have or achieve that relates to the ability to perform physical activity (Nieman, 2003)
Introduction

Maintaining a healthy weight during childhood and adolescence may reduce the risk of becoming overweight or obese as an adult; however, data are lacking that directly link fitness levels in youth to health as an adult. Despite this limitation, fitness testing is of great value to all involved. Test results can provide a measure of fitness level and identify areas that need improvement. Performance can be tracked over time and can be used as an indication of risk for developing certain chronic diseases. Importantly, test results can be a teaching tool for teachers and students in fitness education programs. In analyzing test results, however, one must consider the reliability and validity of the scores. A test is considered valid if it measures what it is intended to measure, while a reliable test is one that consistently produces valid results. A test can be reliable and not valid. For example, a test can repeatedly measure incorrect information; making it reliable, yet not valid. It is true that contemporary children are participating in less physical activity, but are they less fit? Some studies say no (Welk & Blair, 2001; Pangrazi & Corbin, 2001). Limited data are available regarding the physical fitness levels of American children.

Data from the National Child and Youth Fitness Survey (NCYFS) conducted in 1987 and 1988 provide the most comprehensive information to date; however, because criterion standards were not established at the time, one cannot directly determine if the fitness results reflect high or low levels of fitness (Welk & Blair, 2001). Welk & Blair, (2001) cited Blair et al. (1989) who conducted a study on the participants involved in the
NCYFS using the *FITNESSGRAM* standards (Welk & Blair, 2001). The results indicated that the majority of students in the sample passed the health related criterion standards used in *FITNESSGRAM* (Welk & Blair, 2001). The authors also cited Corbin and Pangrazi (1992) who compiled 30 years of data from upper body strength assessments (pull-up and flexed arm hang) and found little change over time in the passing rates for children on muscular fitness tests (Welk & Blair, 2001). Many factors affect the physical fitness of children and many are outside of the person’s control. For example, family history, sex, and race can be negative risk factors associated with cardiovascular disease. The child’s initial fitness level, maturation, overweight and obesity are also contributing factors to changes in fitness over time (Welk & Blair, 2001; Pangrazi & Corbin, 2001). Research shows that heredity and maturation affect fitness performance as reflected in fitness test scores (Pangrazi & Corbin, 2001). Performance standards typically increase as children mature (Pangrazi & Corbin, 2001). Age also plays a role in fitness performance. A child only three months older than his or her peer is likely to perform better, regardless of training. Moreover, maturation causes major changes in body composition, independent of changes in fitness. The timing of this is largely determined by genetics. Therefore, effective programs must incorporate developmentally appropriate activities suited to the child’s level of maturity (Pangrazi & Corbin, 2001). An attempt has been made to select the best and safest physical fitness assessments based on current knowledge and practicality. *FITNESSGRAM* administrators avow that the quality of the child’s movement in performing each fitness test is critical. If an item cannot be done in a slow controlled fashion or if pain is experienced, the item should not be done by that child (Plowman, 2001).
Research has consistently shown a positive, bi-directional relationship between physical activity and physical fitness (Welk & Blair, 2001; Rowlands, Easton, & Ingledew, 1999). But how much change is expected? Can children be trained to become more physically fit? The answer is yes. Limited research findings support the notion that muscular strength and endurance can be improved during childhood years (Faigenbaum et al., 1996; Faigenbaum et al, 1999; Fleglal et al., 2002). Faigenbaum et al. (1999) compared the effects of a low repetition-heavy load resistance-training program and a high repetition-moderate load resistance-training program on the development of muscular strength and muscular endurance in children age 5 – 11 (Faigenbaum et al, 1999). The prospective, controlled trial employed twice-weekly training sessions over eight weeks. The authors concluded that different training programs could enhance muscular strength and muscular endurance of children. Assessing the fitness levels of children is a daunting, yet feasible task. Many studies health promotion interventions have examined changes in PA over time, but not many have actually assessed changes in physical fitness levels (Pangrazi & Corbin, 2001; Rowlands et al., 1999; Faigenbaum et al., 1996; Faigenbaum et al, 1999; Fleglal et al., 2002).

A recent trend has emerged in which health-related physical fitness test scores are interpreted using criterion-referenced standards (Chun, Corbin, & Pangrazi, 2000; Linacre, 2000; Marrow & Falls, 2001). A criterion-referenced assessment gives an indication of how well students are performing on specific goals or standards, rather than just how their performance compares to a norm. In contrast, a norm-referenced test is designed to compare students to each other. Norm-referenced tests sort and rank students. They do not assess whether the student has met the desired standard or criterion. A
criterion-referenced test includes a predetermined standard linked to some specific behavior or attribute. A health-related criterion-referenced standard represents a desirable level of health that should be attainable by the majority of the population with appropriate physical activity (Chun et al., 2000). With fitness tests, the criterion is often a health outcome such as heart disease, body fatness, low back pain, etc. (Chun et al., 2000; Marrow & Falls, 2001). Criterion-referenced assessments must be able to accurately classify individuals into categories based on appropriate standards (Chun et al., 2000). The validity of a criterion-referenced test is defined as the accuracy of classifications (Chun et al., 2000; Marrow & Falls, 2001). According to the FITNESSGRAM reference guide, the most important interpretation of a criterion-referenced fitness test score is the information it provides about the student's health status. Therefore, the FITNESSGRAM developers concluded that criterion-referenced standards should be used when interpreting FITNESSGRAM scores (Marrow & Falls, 2001). To validate a criterion-referenced standard, the criterion must first be determined (Chun et al., 2000; Marrow & Falls, 2001). Therefore, the remainder of this review will explore current research regarding the validity, reliability, and criterion-referenced standards of tests included in the FITNESSGRAM physical fitness test battery.

**Aerobic Capacity**

Many words are used to describe this aspect of physical fitness including cardiovascular fitness, aerobic power, aerobic capacity and physical work capacity. These terms are used interchangeably. The Cooper Institute refers to aerobic capacity as a functional (physiological) capacity (Cureton & Plowman, 2001). FITNESSGRAM advocates using one of three tests to measure aerobic capacity. Those tests include The
PACER test, a one-mile walk/run or a one-mile walk test. Aerobic capacity (VO\textsubscript{2max}) expressed relative to body weight (ml×kg\textsuperscript{-1}×min\textsuperscript{-1}) measured on the treadmill is the criterion against which \textit{FITNESSGRAM} field tests of aerobic capacity have been validated (Cureton & Plowman, 2001). The \textit{FITNESSGRAM} Reference Guide reports the reliability of measuring VO\textsubscript{2max} in youth as high and acceptable for a criterion measure of physical fitness (See Table 7) (Cureton & Plowman, 2001; Corbin & Pangrazi, 2001). The reliability of the three field tests of aerobic capacity is high with consistently high reliability coefficients for the PACER and mile walk test (Cureton & Plowman, 2001). The three field tests have moderately good and approximately equal validity in children 10 years of age and older. For children 9 years of age and older, the reliability of the one-mile run is high with coefficients above .80 (See Table 8) (Cureton & Plowman, 2001). Cureton and Plowman (2001) summarized the results of four studies reporting the reliability of the PACER test in youth (See Table 9). Reliability coefficients were above .84 with no significant mean differences between two tests (Cureton & Plowman, 2001). The reported reliability of VO\textsubscript{2max} estimated from the walk test was high with an intraclass correlation of .91 for repeat measures on 21 boys and girls 14 – 18 years of age (Cureton & Plowman, 2001).

\textit{PACER test}

The concurrent validity of the PACER test has been established in numerous studies by correlating the VO\textsubscript{2max} at the end of the test or the highest test stage (running speed) attained with VO\textsubscript{2max} directly measured on the treadmill (Cureton & Plowman, 2001). Cureton and Plowman (2001) outlined studies that have measured the concurrent validity of the PACER test and found it to be similar to those for the one-mile run,
indicating that the PACER has moderate concurrent validity as a field test of VO$_{2\text{max}}$. Welk, et. al (2004) reported validation studies of the PACER test yielding valid estimates of VO$_{2\text{max}}$ ($r = .72, \text{SEE} = 5.26 \text{ ml\cdotkg\cdotmin}$) in both children and adolescents. Reported test–retest reliability estimates (intraclass correlations) ranged from .89 to .93 (Welk et al., 2001). Furthermore, power calculations indicated that a sample size of 117 would allow detection of a significant difference in VO$_{2\text{max}}$ with a power of .97 at a type I error level of .05 for a two-tailed test and a moderate effect size of .50 as measured by Cohen’s $d$. (Welk et al., 2001). Mahar et al (2004) examined the test-retest retest reliability of the PACER test and the equivalence reliability of the mile run/walk and PACER from both a criterion-referenced and norm-referenced framework. The study of 266 elementary school children showed a significant gender effect. The percent of boys that passed the PACER (68%) was similar to the percent of boys that passed the mile run/walk (66%); however, the percent of girls that passed the PACER (96%) far exceeded the percent of girls that passed the mile run/walk (65%). Criterion-referenced reliability was estimated with proportion of agreement (Pa) and modified kappa (Kq) using FITNESSGRAM standards – Pa = .97 (Kq = .94) for girls and Pa = .82 (Kq = .65) for boys (Mahar et al., 1997). The high level of agreement for girls was found because of the low criterion-referenced standards, which allowed 99 of 104 girls to pass both trials of the PACER. Criterion-referenced equivalence reliability of the mile run/walk and PACER was moderate for boys (Pa = .83, Kq = .65) and low for girls (Pa = .66, Kq = .33) (Mahar et al., 1997). The authors illustrated that the low level of classification agreement for girls was also explained by the low standards for the PACER for this age group (Mahar et al., 1997). Norm-referenced test-retest reliability of the
PACER, estimated with an intraclass correlation ($R_{xx}$) from a one-way analysis of variance model exhibited a high reliability estimate for the two trials ($R_{xx} = .89$ for boys and $R_{xx} = .89$ for girls) and an acceptable reliability for a single trial ($R_{xx} = .80$ for boys and $R_{xx} = .79$ for girls) (Mahar et al., 1997). The authors reported moderate Pearson correlations between the mile run/walk and PACER ($-.59 \leq r \leq -.67$) (Mahar et al., 1997). Moreover, the PACER test has a high content validity (Cureton & Plowman, 2001). The VO$_2$ required is submaximal at earlier stages and increases progressively each minute up to maximal; closely resembling a graded, speed-incremented treadmill test used in the laboratory to directly measure VO$_{2\text{max}}$. Because running speed is controlled and maximum effort is only required at the end of the test, variation in pacing has little influence on test outcome and motivation is likely to be higher than during the one-mile walk/run test in which a sustained (near-maximal) intensity is required throughout (Cureton & Plowman, 2001). Although a range of reliability coefficients has been reported, the consensus is that the reliability of measuring VO$_{2\text{max}}$ in youth is high and acceptable for a criterion measure of physical fitness (Cureton & Plowman, 2001).

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Test Type</th>
<th>Reliability Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boileau et al. (1977)</td>
<td>21 M, 11-14 y Walk</td>
<td>$r = .87$</td>
<td></td>
</tr>
<tr>
<td>Cunningham et al. (1977)</td>
<td>66 M, 10 y   Walk/Run</td>
<td>$r = .56$</td>
<td></td>
</tr>
<tr>
<td>Cureton (1976)</td>
<td>27 M &amp; F, 7-12 y Walk</td>
<td>$r = .88$</td>
<td></td>
</tr>
<tr>
<td>Paterson et al. (1981)</td>
<td>8 M, 10-12 y Walk</td>
<td>R = .47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jog</td>
<td>R = .87</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Run</td>
<td>R = .95</td>
<td></td>
</tr>
</tbody>
</table>
### Table B2. Reliability of the One-Mile Run Test in Children and Adolescents

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Reliability Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bono et al. (1991)</td>
<td>15 M &amp; 15 F, 5th grade</td>
<td>r = .91</td>
</tr>
<tr>
<td></td>
<td>15 M &amp; 15 F, 8th grade</td>
<td>r = .93</td>
</tr>
<tr>
<td></td>
<td>15 M &amp; 15 F, 11th grade</td>
<td>r = .98</td>
</tr>
<tr>
<td>Krahenbuhl et al.</td>
<td>34 F, 1st grade</td>
<td>r = .82a</td>
</tr>
<tr>
<td>(1978)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rikli et al. (1992)b</td>
<td>49 M, 3rd grade 20 M &amp; 16 F,</td>
<td>r = .92a R = .53, .39</td>
</tr>
<tr>
<td></td>
<td>Kindergarten</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 M &amp; 17 F, 1st grade</td>
<td>R = .56, .54</td>
</tr>
<tr>
<td></td>
<td>45 M &amp; 52 F, 2nd grade</td>
<td>R = .70, .71</td>
</tr>
<tr>
<td></td>
<td>53 M &amp; 63 F, 3rd grade 44 M &amp;</td>
<td>R = .84, .90 R</td>
</tr>
<tr>
<td></td>
<td>37 F, 4th grade</td>
<td>.87, .85</td>
</tr>
</tbody>
</table>

Notes: r = interclass reliability; R = intraclass reliability for a single trial  
(1) 1600-m run / (b) First coefficient is for males, second is for females

### Table B3. Reliability of the PACER Test in Children and Adolescents

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Reliability Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dinschel (1994)</td>
<td>57 M &amp; 44 F, 4-5th grade</td>
<td>R = .84</td>
</tr>
<tr>
<td>Leger et al. (1988)</td>
<td>139 M &amp; F, 6-16 y</td>
<td>r = .89</td>
</tr>
<tr>
<td>Liu et al. (1992)</td>
<td>20 M &amp; F, 12-15 y</td>
<td>R = .93</td>
</tr>
<tr>
<td>Mahar et al. (1997)</td>
<td>137 M &amp; 104 F, 10-11 y</td>
<td>R = .90</td>
</tr>
</tbody>
</table>

Note: r = interclass reliability; R = intraclass reliability for a single trial
Table B4. Concurrent Validity of the PACER Test in Children and Adolescents

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Validity Coefficient</th>
<th>SEE (ml×kg$^{-1}$×min$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armstrong et al. (1988)</td>
<td>77 M, 11-14 y</td>
<td>0.54</td>
<td>5.3</td>
</tr>
<tr>
<td>Barnett et al. (1993)</td>
<td>27 M &amp; 28 F, 12-17 y</td>
<td>0.74</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>23 M &amp; 18 F, 14-16 y</td>
<td>.82$^b$</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>18 F, 14-16 y</td>
<td>.85$^c$</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.72$^a$</td>
<td>5.4</td>
</tr>
<tr>
<td>Boreham et al. (1990)</td>
<td>23 M, 14-16 y</td>
<td>0.64</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>18 F, 14-16 y</td>
<td>0.9</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>23 M &amp; 18 F, 14-16 y</td>
<td>0.87</td>
<td>3.9</td>
</tr>
<tr>
<td>Leger et al. (1988)</td>
<td>188 M &amp; F, 8-19 y</td>
<td>0.71</td>
<td>5.9</td>
</tr>
<tr>
<td>Liu et al. (1992)</td>
<td>22 M, 12-15 y</td>
<td>0.65</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>26 F, 12-15 y</td>
<td>0.51</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>48 M &amp; F, 12-15 y</td>
<td>0.69</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.72$^a$</td>
<td>5.3</td>
</tr>
<tr>
<td>Van Mechelen et al. (1986)</td>
<td>41 M, 12-14 y</td>
<td>0.68</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>41 F, 12-14 y</td>
<td>0.69</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>82 M &amp; F, 12-14 y</td>
<td>0.76</td>
<td>4.4</td>
</tr>
</tbody>
</table>

$^a$Cross-validation of the Leger et al. (1988) equation  
$^b$Prediction from age, sex, and maximal shuttle speed  
$^c$Prediction from triceps skinfold, sex, and maximal shuttle speed

**Muscular Strength and Endurance**

It is important to measure muscular fitness in order to establish a baseline by which to begin a training and/or exercise program. Muscular strength is defined as the
maximal amount of force preformed by a muscle or group of muscles, while muscular endurance is the ability of the muscle to continue to perform without fatigue. Flexibility refers to the range of motion about a joint. Considerable variability exists in protocols used to assess musculoskeletal fitness (Plowman, 2001). These variations can greatly influence the safety and efficacy of the assessment as well as affect validity and reliability (Plowman, 2001). The musculoskeletal fitness assessments included in the FITNESSGRAM are the curl-up test, 90-degree push-up test, the Back-Saver Sit-and-Reach test, trunk lift test, and the shoulder stretch (Plowman, 2001; Meredith & Welk, 2005). Instructions for administering these tests are very specific and are described in the FITNESSGRAM Test Administration Manual (Meredith & Welk, 2005). The following sections of this review outline the validity, reliability and criterion-referenced standards for assessing muscular strength and endurance.

**Curl-up test**

The FITNESSGRAM recommends a cadence-based curl-up test for measuring abdominal strength and endurance (Plowman, 2001; Meredith & Welk, 2005). The use of a cadence helps to eliminate concerns of the ballistic nature of one minute all-out speed tests. More importantly, the cadence allows participants to focus on their own performance instead of competing with their peers (Plowman, 2001). The FITNESSGRAM administrators’ decision to employ the curl-up test over other full sit-up assessments was based on extensive research and biomechanical analyses of arm placement, leg position, feet support, and range of motion of the movement (Plowman, 2001). Numerous studies have evaluated the validity and reliability of the curl-up test; however, because of varying protocols and measurement techniques, much of the data are
not directly comparable. Moreover, the majority of the studies tested college students and older adults. No data is consistent regarding the validity and reliability of the curl-up test on children and adolescents.

**90-degree Push-up test**

Many assessments exist to measure upper arm and shoulder girdle strength including the pull-up, modified pull-up and free hanging pull-up, chin-up, flexed arm hang, and push-up tests (Plowman, 2001). While some tests require a cadence, others employ an all-out effort within a time limit (i.e. the one-minute push-up and pull-up tests). The recommended test of upper body strength and endurance for the FITNESSGRAM is the 90-degree push up at a cadence of one push-up every three seconds (Plowman, 2001). The most commonly used assessment of upper arm girdle strength is the pull-up test; however, the 90-degree push up test has practical advantages over the pull-up test. Primarily, the push-up test requires no equipment and very few zero scores occur (Plowman, 2001). Plowman (2001) reported acceptable reliability values of the cadence-based 90-degree push-up test in elementary school children (R= .64 -.99.) In a study to determine the objectivity and stability reliability of the 90° push-up test for elementary, high school, and college-age students, McManis Baumgartner and Wuest (2000) found objectivity coefficients of .46 and .75 for the elementary school students. Elementary school students were videotaped performing the exercise to determine objectivity (McManis, Baumgartner, & Wuest, 2000). The reliability coefficients were between .22 and .87, with 5 of the 7 coefficients greater than .70. However, the study exposed several administration problems with the administering 90-degree push-up test (Plowman, 2001;
McManis et al., 2000). To curtail this issue, students must be carefully monitored by a test administrator to ensure proper technique is used throughout the test.

**Flexibility**

*Trunk Extension Test*

The trunk lift test is a measure of both trunk extensor strength and lumbar flexibility (Plowman, 2001). Trunk extension strength and endurance has been shown to predict both first time and recurrent low back pain (Plowman, 2001). Plowman (2001) reports criterion validity of this test ranging from .68 - .70; however, data are not available evaluating the validity and reliability of this test in children (Plowman, 2001). Goniometer and flexometer measurements are the criterion measure to which this test is validated (Plowman, 2001; Meredith & Welk, 2005).

*Back-Saver SAR*

The various forms of SAR tests were originally intended to measure low back and hamstring flexibility (Martin, Jackson, & Morrow, 1998). Early research validated these tests against Leighton flexometer measures of combined trunk and hip flexibility with reasonably acceptable results (Martin et al., 1998). The correlation between the two legged SAR and the one legged BSAR has been reported to be between .91 and .92 in 79 7 – 13 year old boys and girls (Plowman, 2001). In a summary of four different studies evaluating the validity of the BSAR, Plowman (2001) reports high intraclss reliability with correlations of .93 -.99 and 95% confidence intervals of .89 to .99. Participants in these studies included both males and females aged 11 to 41 and the range of coefficients includes both right and left legs (Plowman, 2001). Hartman and Looney (2003) studied 179 elementary school children to determine the norm-referenced and criterion-
referenced reliability and validity of the Back-Saver Sit-and-Reach Test used in the *FITNESSGRAM* battery (Harman & Looney, 2003). The students were randomly selected and tests were administered in random order across two days. The authors reported a high norm-referenced reliability for the BSAR (.98-.99) for both boys and girls. Criterion-referenced test-retest reliability for the right leg was .90 and .80, respectively, for boys; and .91 and .82 for girls, indicating the participants was classified consistently across days. Norm-referenced validity coefficients (Pearson product-moment correlations, r) of the BSAR as a measure of hamstring flexibility were moderate for boys (.67 and .68, right and left legs, respectively) and moderately low for girls (.47 and .44, right and left legs) (Hartman & Looney, 2003). However, correlation coefficients of the BSAR as a measure of low back flexibility were extremely poor for boys and girls, with coefficients ranging from .003 to .06 (Hartman & Looney, 2003). Criterion-referenced validity of BSAR for hamstring flexibility was low for right and left legs (Km: .48, .58, respectively), for both boys and girls (Km: .40, .22) (Hartman & Looney, 2003).

**Body Composition**

Body composition refers to an individual’s fat-free mass relative to their body mass. Research has consistently shown that excessive body fat is associated with a higher cardiovascular disease risk (CDC “Defining overweight,” 2006; Lohmman & Falls, 2001). Several tools are available to assess body composition. The most common field tests are skinfolds, Body Mass Index (BMI), waist-to-hip circumference, and bioelectrical impedance (BIA). Underwater weighing is considered the gold standard for measuring body composition. *FITNESSGRAM* uses two-site skinfolds and BMI as the field methods to estimate body fatness. Although two-site skinfolds (triceps and calf) are the
recommended protocol for assessing body composition in children and adolescents, its use is impractical due to high testor error, invasiveness, and inefficiency (Lohmman & Falls, 2001). The current study used BMI as a measure of body composition.

**BMI**

The Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommend the use of Body mass index (BMI) to screen for overweight in children and teens aged 2 through 19 years (CDC “About BMI,” 2006). BMI is a crude measurement of body composition. It is calculated from the child’s weight and height. BMI is a reliable indicator of body fatness for most children and teens (CDC “About BMI,” 2006). BMI does not directly measure body fat; however, research has shown that BMI correlates to direct measures of body fat such as underwater weighing and dual energy x-ray absorptometry (DXA) (CDC “About BMI,” 2006).

After BMI is calculated in children, the BMI number is plotted on the CDC BMI-for-age growth charts to obtain a percentile ranking (See Appendix G - H) (CDC “About BMI,” 2006). The CDC growth charts include population reference growth curves for children and adolescents age 2 – 20y (Butterfield et al., 2007). The percentile ranking indicates the relative position of the child’s BMI number among children of the same age and gender (CDC “About BMI,” 2006; Fleglal et al., 2002). The growth charts also illustrate weight categories for children and teens: underweight, healthy weight, at risk of overweight, and overweight (See Appendix G - H) (CDC “About BMI,” 2006). BMI standards for adults are not age specific. For children, however, the distribution of BMI varies by age (CDC “About BMI,” 2006). BMI does not increase successively with age among children and adolescents. Beginning at age two, BMI tends to first fall and then
rise again (Fleglal et al., 2002). BMI, although calculated the same, is interpreted differently for children than adults. The criteria for use to interpret the meaning of the BMI number for children and teens are different from those used for adults. Because the amount of body fat changes with age and differs between girls and boys, the CDC BMI-for-age growth charts were created to account for these differences and allow translation of a BMI number into a percentile ranking for the child’s gender and age (CDC “About BMI,” 2006). For adults, on the other hand, BMI is interpreted via categories that do not consider sex or age. The BMI-for-age reference data from the CDC growth charts can be used to compare a child’s BMI with the BMI distribution of a reference group of children of the same age but not necessarily the same stature (Fleglal et al., 2002). Importantly, BMI percentiles are related to health risk. BMI-for-age is recommended for use in identifying children as either at risk of overweight or overweight (CDC “About BMI,” 2006; Fleglal et al., 2002).

A study by Lloyd, et al. (2003) evaluated the influence of body size and composition on the performance of FITNESSGRAM test items and also evaluated the impact of adjusting FITNESSGRAM scores for the effect of body composition on percentile rankings and the achievement of criterion-referenced standards (Lloyd, Bishop, Walker, Sharp, & Richardson, 2003). The study found that body compositions had significant moderate negative correlations with PACER, curl-up, and push-up scores (r = .30 to .49). The scores were then adjusted for sum of skinfolds for each of the tests. The authors concluded that the relationship between sum of skinfolds and the PACER, curl-up, and push-up scores appears to be sufficient to justify the use of adjusted scores.
for evaluating cardiorespiratory endurance and upper body muscular strength and endurance independent of sum of skin folds (Lloyd et al., 2003).

**Conclusion**

Obesity has drastically increased in both children and adults in the past 20 years (CDC “Overweight prevalence,” 2006; Lohmman, 2001). Results from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) administered by the CDC, indicate that an estimated 17 percent of children and adolescents ages 2 to 19 years are overweight – over 9 million children (CDC “Overweight prevalence,” 2006; CDC “State-based programs,” 2006). Body fatness in children and youth increase the likelihood of obesity-related adult diseases including coronary heart disease, hypertension, hyperlipidemia, and type II diabetes (CDC “Overweight prevalence,” 2006; Lohmman, 2001; CDC “State-based programs,” 2006). Overweight and obesity trends in Georgia are just as alarming. For example, 59% of Georgia adults are overweight or obese; 26% of Georgia high-school students and 33% of Georgia middle school students are overweight or at risk of being overweight (CDC “State-based programs,” 2006). Overweight and obesity in America has reached its tipping point to becoming an epidemic. Albeit the enormity of the disease, something can be done to curtail its spread and eventually reduce the trend. That something begins with our children. Insalubrious habits learned as a child are likely to continue into adulthood. Therefore, health educators must focus on educating children and parents on the importance of daily physical activity and healthy eating habits. The current study advocates increasing daily physical activity among children and adolescents by introducing them to fun fitness
activities that help maintain body weight and improve cardiovascular and musculoskeletal fitness.
APPENDIX C

FITNESSGRAM CURL-UP TEST

Diagram A. The start of the Curl up test

Diagram B. The end of the Curl up test

APPENDIX D

FITNESSGRAM PUSH-UP TEST

APPENDIX E

FITNESSGRAM BACK-SAVER-SIT-AND-REACH TEST

APPENDIX F

UNIT PLAN
Boys & Girls Club Team
Georgia Southern University
Physical Activity Team
Department of Health & Kinesiology
CLASSROOM ACTIVITIES

January 22 – 24

**Monday**
Unit: 1st Week Management

**Activity:**
Orientation Lesson
*Warm up:*
  - SPARK “simple 6
Cooperative games
Cool-down

**Wednesday**
Unit: 1st Week Management

**Activity:**
Minor’s Assent
*Warm up:*
  - SPARK “simple 6”
Tag Games (Bulldog)
Stop & Go Games/ Cooperative games
Cool-down

Note: The first two days should be spent getting to know the kids in your class. There are plenty of cooperative/team-building games in the Cooperative games and Aerobic Games section of your unit plan. These games are designed to help you establish your authority while also getting to know everyone. They also allow you to assess and adjust any constraints such as time, equipment, and space. Every activity session should include a warm-up and cool-down.

January 29 – 30

**Monday**
Unit: Fitness Testing
Testing Make-up day

**Activity:**
FITNESSGRAM

**Wednesday**
Unit: Cooperative Games/ Fitness

**Activity:**
*Warm up*
Cooperative Games
Cool-down

Note:
On Monday, talk to your class about the *FITNESSGRAM* and the importance of the testing. Do not discuss student’s scores with other students. Emphasize its use to track your fitness overtime. Emphasize the positive. Show them how the activities we perform everyday can help them improve their scores.
Boys & Girls Club Team  
Georgia Southern University  
Physical Activity Team  
Department of Health & Kinesiology  
CLASSROOM ACTIVITIES

**Feb 05 – 07**  
**Monday**  
**Unit:** Aerobic Games

**Activity:**  
*Warm-up:*  
- Bulldog  
- Workout Tag  

Crazy Cones  
Super Circulation  
5 Servings Tag  

**Cool-down**

**Note:** The warm-up and cool-down does not have to be the same everyday. You can incorporate the days’ activity into the warm-up so as not to get bored. Aerobic activities are designed to raise the student’s heart rate above resting. The goal is to elevate their heart rate for at least 10 and up to 20 minutes. Be sure to add water breaks. Keep the class moving as much as possible. Make sure that equipment set up and transition times are minimal. You can also incorporate other lessons with each game (i.e. health, fitness, history, etc). Take advantage of the “teachable moments.”

**Wednesday**  
**Unit:** Aerobic Activities

**Activity:**  
*Warm-up:*  
- Bulldog  
- Awesome Add-On  

Heart Alert  
Fat Grabbers  
Super Circulation  

**Cool-down**

February 12 – 14  
**Monday**  
**Unit:** Fun and Fitness Circuits

**Activity:**  
*Warm-up:*  
Choose 3 – 8 stations per day  

**Cool-down**

**Note:** At each station, have the name and/or diagram of each activity. See handouts in your packets. Set up stations in a circular motion to work different muscles at each station. Incorporate aerobic and muscular strength and endurance activities. Start with 20-second stations and increase time. Be sure to include a water break or a break station.

**Wednesday**  
**Unit:** Fun and Fitness Circuits

**Activity:**  
*Warm-up:*  
Add 2 or more new stations  

Obstacle Course*  

**Cool-down**

*Obstacle Course: Use the station diagrams, but split the group into teams and set the stations up in a distinct order. Have each person on the team complete a certain number of each exercise in order then back to the finish (i.e. 10 jumping jacks, then 5 push-ups, etc). The first team to finish the activities *correctly* wins (emphasize proper technique).
February 19 – 21
Bulloch County Winter Break

February 26 – 28

**Monday**

**Unit:** Dynamic Dance

**Activity:**
- Warm-up
- Hokey Pokey
- The Chicken
- Mexican Hat
- Bunny Hop
- Cool-down

**Wednesday**

**Unit:** Dynamic Dance

**Activity:**
- Warm-up
- Electric slide
- Cha Cha slide
- Popular dance
- Freestyle / Soul Train line
- Cool-down

Note: If you are uncomfortable with the dance lesson, do an extended warm-up and cool down. But make sure the dance lesson lasts at least 20 minutes. Allow children to bring in CD’s (edited version) for Wednesday’s freestyle or bring in your own music. Add a fitness component to the Soul Train line for those who do not want to dance. i.e. everyone has to come down the line doing some type of fitness activity like jumping jacks, hop on one foot, etc. You can change the dances to suit your age group.
Boys & Girls Club Team
Georgia Southern University
Physical Activity Team
Department of Health & Kinesiology
CLASSROOM ACTIVITIES

**March 05 – 07**
*FITNESSGRAM*

**March 12 – 14**
Georgia Southern University Spring Break

**March 19 – 21**
Your choice:
Teacher Led Exercises/ Astronaut Games or Aerobic Games

**March 26 – 28**
Field Day

**Your class will participate in the Field Day on ONE of the two days. Use the other day as a free day, goodbye party, etc.**
APPENDIX I

WEEKLY PHYSICAL ACTIVITY EVALUATION
<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Session started on time.</th>
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<td>1</td>
<td></td>
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<tr>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>Session included a warm-up activity.</td>
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<td>3</td>
<td>Yes</td>
<td>No</td>
<td>Activities were conducted in a safe manner.</td>
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<td>4</td>
<td>Yes</td>
<td>No</td>
<td>Participants received clear concise instructions.</td>
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<td>5</td>
<td>Yes</td>
<td>No</td>
<td>Participants were active at least 50% of session time</td>
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<td>6</td>
<td>Yes</td>
<td>No</td>
<td>Equipment set up and transition times were minimal.</td>
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<td>7</td>
<td>Yes</td>
<td>No</td>
<td>There was an adequate learner/equipment ratio.</td>
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<td>8</td>
<td>Yes</td>
<td>No</td>
<td>Group sizes were appropriate.</td>
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<td>9</td>
<td>Yes</td>
<td>No</td>
<td>Participants were encouraged to be physically active during the activity session</td>
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<tr>
<td>10</td>
<td>Yes</td>
<td>No</td>
<td>Participants were praised/rewarded for being physically active during the session.</td>
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<td>11</td>
<td>Yes</td>
<td>No</td>
<td>Participants appeared to enjoy the activities.</td>
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<td>12.</td>
<td>Yes</td>
<td>No</td>
<td>I was enthusiastic about the activities.</td>
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<td>13.</td>
<td>Yes</td>
<td>No</td>
<td>Session included a cool-down.</td>
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<td>14.</td>
<td>Yes</td>
<td>No</td>
<td>Session lasted at least 30 minutes.</td>
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<td>15.</td>
<td>Yes</td>
<td>No</td>
<td>Disciplinary problems were minimal.</td>
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Georgia Southern University
Institutional Review Board

For electronic submission: Your proposal narrative should already be completed and saved. Next complete cover page and “Save As” a word document to your computer or disk named “Coverpage_Year_Month_Date_lastname, First initial.doc”. Then open and complete Informed Consent Checklist.

Application for Research Approval

Name of Principal Investigator:
Drew Zwald, Ph.D.

Email:
dzwald@georgiasouthern.edu

Phone: 912-681-5266

Address: P.O. Box 8076
Statesboro, GA, 30460

Project Start Date: September 5, 2006
Project End Date: April 27, 2007

Date of IRB education completion: 08/03/05 (attach copy of completion certificate)

Check one: □ Student  □ Faculty/Staff
If student project please complete advisor’s information below:

Advisor’s Name:

Advisor’s email:

Advisor’s phone:
P.O. Box:

Department:

All applicants please complete all fields below:

Project Information:

Title: The effectiveness of the Sports, Play, & Active Recreation for kids (SPARK) program in increasing physical activity and improving cardiovascular and musculoskeletal fitness among children and adolescents

Project Duration (in months): 8
Number of Participants: 500

Brief (less than 50 words) Project Summary:
The study will measure the effectiveness of the Sports, Play, & Active Recreation for kids (SPARK) program in increasing physical activity and improving cardiovascular and musculoskeletal fitness among children and adolescents. The study also aims to exa

Please fill in if applicable:

Name of Georgia Southern or External Funding Source: General Mills Champions for Healthy Kids Youth Nutrition and Fitness Grant
Compliance Information:

Please indicate if the following are included in the study:

- ☒ Informed Consent Document
- ☐ Greater than minimal risk
- ☒ Research Involving Minors
- ☐ Deception
- ☒ Generalizable knowledge (results are intended to be published)
- ☐ Survey Research
- ☐ At Risk Populations (prisoners, children, pregnant women, etc)
- ☐ Video or Audio Tapes
- ☒ Medical Procedures, including exercise, administering drugs/dietary supplements, and other procedures

IRB Use Only

Type of Review
- ( ) Full Board
- ( ) Expedited
- ( ) Exempt

1st Reviewer:
X:_____________  Date: __________

2nd Reviewer:
X:_____________  Date: __________

NOTE: All thesis and dissertation work by definition is to create generalizable knowledge.

Signature of Applicant
X:  
Date: 8/18/2006

Signature of Advisor (if student) / Dept.
Chair (if faculty)
X:  
Date: 08/18/2006

Please submit this protocol electronically to the Georgia Southern University Institutional Review Board, c/o The Office of Research Services & Sponsored Programs, P.O. Box 8005. The application should contain a summary of the project, informed consent form(s), instruments, questionnaires, etc. Questions or Comments can be directed to 486-7758 or oversight@georgiasouthern.edu
APPENDIX K

IRB PROPOSAL NARRATIVE

Personnel
Drew Zwald, Ph.D., Associate Professor, College of Health and Human Sciences – full access; Daniel Czech, Ph.D. Associate Professor and Graduate Director College of Health and Human Sciences – access limited to psychology information only; Padmini Shankar, Ph.D., R.D., L.D., Associate Professor of Nutrition and Food Science – access limited to nutrition information only; Jonathan N. Metzler, ABD, Assistant Professor – full access for statistical consultation; Latrice Sales, Graduate Student, College of Health and Human Sciences – full access. All GSU faculty have NCI online training certifications on file.

Purpose
The study will measure the effectiveness of the Sports, Play, & Active Recreation for kids (SPARK) program in increasing physical activity and improving cardiovascular and musculoskeletal fitness among children and adolescents. The study also aims to examine the effects of the SPARK program on psychological well being in children and adolescents at the Bulloch County Boys & Girls Club (BGC) in Statesboro, Georgia. The study also aims to increase knowledge and awareness of the diet-disease relationship and promote sustainable healthful dietary patterns among children and adolescents. The research questions are:

a. Is the SPARK curriculum effective for improving cardiovascular and musculoskeletal fitness among adolescents (10 – 17 years old)?

b. Does participation in the SPARK program increase optimism, self esteem, exercise motivation, and decrease social physique anxiety in obese adolescents (12-17 years old)?

c. Does participation in the program reduce anxiety, and enhance physical appearance perception, behavioral adjustment, and satisfaction in obese children (aged 7-11)?

d. Will participation in the USDA Team Nutrition education program positively influence participants’ ability to make proper nutrition choices, understand the importance of physical activity and long term benefits of proper dietary behaviors?

We hypothesize that the SPARK program will significantly a) increase cardiovascular fitness, musculoskeletal fitness, optimism, self-efficacy, exercise motivation, b) physical appearance perception, behavioral adjustment, and satisfaction, c) reduce social physique anxiety in obese adolescents and older adults and, d) promote healthy eating habits.

Numerous research studies provided support for the SPARK curriculum for cardiovascular health promotion and obesity risk reduction. More precisely, studies have shown a significant positive change in levels of physical activity during and beyond school-sponsored programs, fat intake and in food- and health-related knowledge and behaviors (Caballero, 2003; Hayman et al., 2004; Sallis et al., 1997). Research focused on the efficacy of the SPARK program to improve cardiovascular and musculoskeletal fitness is lacking.

Highly active individuals are typically less pessimistic and more optimistic than inactive/low active individuals (Williams & Lord, 1995). Previous studies have found that improvement in strength is also a strong predictor for exercise adherence (Williams & Lord, 1995). Individuals with high levels of social physique anxiety report more stress during participation in exercise settings, and have been shown to experience more negative thoughts about their...
bodies than others do (Weinberg, 2003). These findings suggest that physical activity promotion, in which is the focus of the SPARK curriculum, can have a positive effect on psychological well being; however, little research has been found that has examined the psychological effects of the SPARK program on obese children and adolescents.

The primary causative factors for overweight and obesity among children and adolescents are unhealthy dietary behaviors and a sedentary lifestyle. Since dietary habits formed during childhood persist into adulthood, intervention strategies are most effective when started in the formative years of life (CDC, 2005). Intervention is needed that focuses on establishing a nutrition-friendly environment by increasing awareness and knowledge of good nutrition and developing the life skills necessary to maintain a healthy lifestyle.

Describe your subjects
Participants will be students attending the Bulloch County BGC in Statesboro, GA. The Club serves approximately 500 youth from various schools in Bulloch County, GA ranging from 9 to 17 years old. Participants will be recruited via announcements and flyers sent home to the parents (See Appendix A). As a service to the community, we will provide daily physical fitness and nutrition education via the SPARK and USDA Team Nutrition programs. However, participation in any of the assessments is voluntary. Participants will be informed of the potential risks and benefits of participating in the study. Participants under 18 years old will take a letter home to their parents describing the nature of the study and will be required to return a signed parental consent form to participate in the study and may also be required to sign a minor’s assent form.

A subsample comprised of students who are members of the 21st Century Community Learning Center (CCLC), a smaller group within the Club, will be used as controls for the study. This group’s attendance and new membership fluctuates throughout the school year; therefore, they cannot be used as a part of the treatment group and will serve as controls. The students in this subsample are representative of the Club’s population. The study will be part of the daily curriculum at the Club; however, we will highlight the voluntary nature of engaging in the research aspect of the program. We will emphasize that each participant has the right to privacy and at any time the right to discontinue his or her involvement in the research project (i.e., providing data).

Methodology (Procedures)
Participants will be recruited via announcements at the BGC and flyers sent home to their parents. Parents who allow their child to participate will be required to review and sign a parental consent form. Upon receiving parental consent, participants 18 years old or younger, will be required to review and sign a minor’s assent form. All students will receive daily nutrition and physical education; while those agreeing to participate in the study will be asked to complete a pre and post nutrition assessment, complete a psychological questionnaire, as well as a physical fitness assessment. The assessments are as follows:

1. The Piers-Harris Children’s Self Concept Scale – Second Edition (Piers, Harris & Harzenberg, 2002) – PHCSCS-2 is a 60-item self-reported scale for children ages 7–18 that assesses general self-esteem in children, and has six subscales: Behavior, Intellectual and School Status, Physical Appearance and Attributes, Anxiety, Popularity, and Happiness and Satisfaction
2. USDA Team Nutrition - USDA's Team Nutrition is an integrated, behavior based, comprehensive plan for promoting the nutritional health of the Nation's children.
Team Nutrition is an initiative of the USDA Food and Nutrition Service to support
the Child Nutrition Programs through training and technical assistance for
foodservice, nutrition education for children and their caregivers, and school and
community support for healthy eating and physical activity.

3. FITNESSGRAM (The Cooper Institute, 1982) – FITNESSGRAM is a health
related physical fitness assessment. Each test item assesses important aspects of a
student's health related fitness, not skill or agility. FITNESSGRAM measures aerobic
capacity via the PACER test, body composition as body mass index (BMI), muscular
strength and endurance using the push up and curl up tests, and flexibility
is measured using the Modified Sit-and-Reach test. (See Appendix B - D)

Upon completion of the initial assessments, we will implement the SPARK curriculum and
USDA Team Nutrition education for six to seven weeks to the treatment group (3 hours per
week of both fitness and nutrition education). The control group will resume their regularly
scheduled activities at the BGC. GSU faculty will make regular visits to the BGC to monitor
progress and adherence to protocols. After six to seven weeks of instruction, participants will
be asked to complete a midway assessment including FITNESSGRAM, PFICSCS-2, and
USDA Team Nutrition and their scores documented. After the final assessments, the control
group will be given the opportunity to participate in the SPARK and USDA Team Nutrition
programs for the remainder of the school term. Also, the control group will receive the
benefit of these programs during summer sessions.

Importantly, if any new students enter the control group, they will be recruited to participate
in the project. Upon voluntary participation, new students will begin the study by providing
anthropomorphim data. The assessments are included in the Appendix and should,
collectively, take approximately two weeks to complete.

Mike Jones, Executive Director of Bulloch County BGC, Inc. affirmed that as of the 2006 –
2007 school year, there are no children with parents who do not speak English. Therefore,
the above instruments and appendices will not be translated to Spanish.

Research involving minors
Parents of children attending the BGC have been informed and have given their consent to
allow their children to participate in all activities conducted at the BGC of Bulloch County,
Inc. (See Appendix E, H). The parents are also required to complete a medical history for
their child, outlining any medical problems that may prevent their child from participating in
physical activity. Any child identified as having a medical problem will be excluded from
the study. Before beginning the research study, parents/guardians of students participating in
the study will be informed on the nature, risks, and benefits of the research study. Throughout
the year, parents/guardians will be briefed on the details and progress of the study via
monthly parent-teacher workshops.

The need for a cardiovascular fitness, obesity prevention, and nutrition education program
with the Bulloch BGC has been confirmed via the General Mills Champions for Healthy Kids
Youth Nutrition and Fitness grant that was awarded to the PI and the BGC (See Appendix G).
The BGC director has reviewed the curriculum and is supportive of the researchers’ efforts to
promote and improve cardiovascular and musculoskeletal fitness as well as identify any
psychological benefit. The study will simply provide objective evaluation of a frequently
used program implemented within the normal BGC curriculum process.
The BGC is primarily financed by grant funds provided by various government and proprietary agencies. Investigators will review the results of the study to improve BGC activities and/or apply for further funding to enhance adolescent fitness of BGC participants.

**Deception**
Not applicable

**Medical procedures**
The majority of the research project personnel have current child CPR certifications. All BGC staff has current CPR and First-Aid certifications and are available to assist if a child should become ill. GSU students helping with the project will be trained on administering all assessments and will be supervised daily by a BGC staff member. The BGC has student accident insurance, which covers any injuries members may sustain while participating in Club related activities. The Club also has D&O insurance, which protects all staff, volunteers, board members, etc. from being financially liable for accidents, injuries or malpractice. Furthermore, the local health center (which is approx. 50ft away) will be briefed of the study and arranged as a first-responder for emergencies. To ensure progress and compliance to procedures, a GSU faculty member will make routine on-site visits. Mike Jones, BGC Director, and Woody Pumphrey, Director of Operations, are on site everyday for supervisory purposes and consultation should any issue arise (See Appendix H).

**Risk.**
The benefits of regular physical activity are innumerable. Engaging in regular physical activity helps improve cardiovascular and musculoskeletal fitness while also reducing the risks of cardiovascular disease (CVD), various cancers and stroke. CVD is the leading cause of morbidity and premature mortality in men and women of all age groups the United States. Primary prevention of CVD beginning in early childhood has been supported by extensive research from many epidemiological, clinical, and laboratory studies. The American Heart Association (AHA) explicitly supports the need for population-based approaches to cardiovascular health promotion and risk reduction (Hayman et. Al, 2004). Therefore, any risk associated with participating in this research study is far outweighed by its personal and societal benefit. Students will be verbally screened for any inherent illness that may hinder their participation in the research project. Any student exhibiting such an illness will be required to produce medical and/or parental consent to continue involvement in the assessments. Furthermore, the BGC has a set protocol to handle any injury a student may incur onsite. Should an injury occur during the research project, that protocol will be followed (See Appendix H). All research personnel will be briefed of this protocol. The risk of participating in the study is no greater than that of participating in the normal activities of the BGC.

Some of the psychological and nutrition questions are private in nature and may cause discomfort in disclosing responses. It is important to note that the participants may stop taking the psychological and/ or nutrition inventories at any time. Students may also be uncomfortable with being weighed; therefore, each student’s weight will be measured in private and only shared with the personnel listed above. Group fitness testing proposes a slight risk of embarrassment to the students. However, personal information such as body composition and individual test scores will not be shared with the group. In addition, students will be informed that testing is not competitive and discouraged from competing
with and/or ridiculing their peers. Acquiring this information is important to all obese youth, researchers, etc. because of its significance in curtailing the epidemic. The implication of the study could be significant for obese youth, as a curriculum of involving regular physical activity has the ability to increase both physical and psychological characteristics needed to combat obesity. Moreover, by assessing psychological aspects associated with physical activity, we hope to further understand psychological mechanisms that may perpetuate engagement in an active, healthy lifestyle.
Dear Parent or Guardian:

We are excited to incorporate a high quality physical activity curriculum into your child’s program at the Boys & Girls Club. The Sports, Play, and Active Recreation for Kids (SPARK) program developed at San Diego State University has been awarded “Exemplary Program” by the U.S. Department of Education. The curricula evolved from a National Institute of Health sponsored study and a California Adolescent Nutrition and Fitness project. Many objective research studies with thousands of young people provided impressive support for the effectiveness of SPARK. We intend to add to the knowledge regarding the SPARK program while providing your child with an established, quality educational experience.

It is important that children feel successful each day, and that they leave the program eager to attend again. That is why we plan to incorporate SPARK’s “S.E.A.D” philosophy. Physical activities will be Safe, Enjoyable, Active, and Developmentally appropriate.

One of our program goals is to actively engage children in sufficient amounts of moderate to vigorous physical activity to improve and/or maintain their physical health and well being. Another goal is to encourage children to get excited about movement so they will seek opportunities to be active outside of the program and as a part of a healthy lifestyle. Additionally, children enhance motor, personal and social skills.

In order to provide the best possible experience for your child, we must all work together as a team! Please remind your child to dress appropriately for physical activity each day (or bring a change of clothes). For comfort and safety, she/he should wear running shoes with rubber soles and shorts, sweat pants, or loose fitting clothing.

Physical activity must be done regularly to achieve health benefits. Therefore, your child’s consistent participation is very important. If she/he is sick or unable to participate in all activities, please let us know via note or phone call prior to the scheduled program. It would be helpful if the note states the specific nature of the ailment and your suggested restrictions.

If you have any questions or concerns, please don’t hesitate to call me, Latrice Sales, my advisor Dr. Zwald or contact the Boys & Girls Club.
Thank you very much.

Latrice Sales
Graduate Student
College of Health and Human Sciences
912-681-5266

Dr. Zwald
Associate Professor
College of Health and Human Sciences
912-681-5266
PARENTAL INFORMED CONSENT

COLLEGE OF HEALTH AND HUMAN SCIENCES

DEPARTMENT OF HEALTH AND KINESIOLOGY

PARENTAL INFORMED CONSENT

Dear Parent or Guardian:

A study will be conducted at your child’s school in the next few weeks. Its purpose is to determine the effectiveness of the Sports, Play, & Active Recreation for kids (SPARK) program in increasing physical activity and improving cardiovascular and musculoskeletal fitness among children and adolescents. In particular, we will measure your child’s height, weight and level of fitness. We will also ask them questions about how exercising makes them feel, along with questions about the foods they eat everyday.

If you give permission, your child will have the opportunity to participate in the research study. Regardless of their participation in the research, your child will receive daily instruction and benefit of the SPARK curriculum. Your child will also receive 2 days of nutrition education each week. Also, your permission certifies that your child does not have any physical ailment or illness that may hinder their participation in the study. The study will last the duration of this school term for 1 hour each day. We will conduct an assessment, approximately every 6 to 7 weeks.

Your child’s participation in this study is completely voluntary. If your child participates in the study, he or she will be engaged in moderate to vigorous physical activity which may impose a greater than minimal physical risk; however, your child will be told that he or she may stop participating in any of the assessments at any time without penalty. The risk of participating in the study is no greater than participating in regular activities of the BGC. If your child experiences any discomfort, he or she will be instructed to let us know immediately. Your child may choose to not answer any question(s) he/she does not wish to for any reason. Your child may refuse to participate in the assessments even if you agree to her/his participation.

In order to protect the confidentiality of your child, your child’s name will be removed from all information recorded during the study prior to data analysis. All information pertaining to the study will be kept in a locked filing cabinet in an office at Georgia Southern University. No one at your child’s school will see the information recorded about your child.

If you have any questions or concerns regarding this study at any time, please feel free to contact Latrice Sales, Exercise Science graduate student or Dr. Zwald, advisor, at 681-5266.

If you are giving permission for your child to participate in the experiment, please sign the form below and return it to The Boys and Girls Club as soon as possible. Thank you very much for your time.
Attached you will find two copies, one copy for your records and the other copy should be returned to me via your child.

**Parental Permission**

Title of project: The Effectiveness of the SPARK Program in Improving Fitness Among Children and Adolescents.

Principle Investigator: Dr. Drew Zwald, P.O. Box 8076, Statesboro, GA 30460, 912-681-5266, dzwald@georgiasouthern.edu

Other Investigators: Dr. Daniel Czech, Associate Professor, College of Health & Human Sciences, P.O. Box 8076, Statesboro, GA 30460, 912-681-5267, drczech@georgiasouthern.edu

Dr. Padmini Shankar, R.D. Associate Professor College of Health and Human Sciences, P.O. Box 8076, Statesboro, GA 30460, 912-681-5785, pshankar@georgiasouthern.edu

Latrice Sales, Graduate Student, College of Health and Human Sciences, P.O. Box 8984, Statesboro, GA 30460, lsales1@georgiasouthern.edu

I, ________________________________, give my child permission to participate in this study.

Parent’s name

I, ________________________________, do not give my child permission to participate in this study.

Parent’s name

Parent signature: _______________________________ Date: _____________________

*By giving my child permission to participate in the study, I understand that medical care is available in the event of injury resulting from research, but that neither financial compensation nor free medical treatment is provided. I also understand that I am not waiving any rights that I may have against the University for injury resulting from negligence of the University or investigators.*
The informed consent procedure has been followed.

Investigator’s Signature: ______________________________ Date: ________________
Hello,

I am Latrice Sales, a graduate student at Georgia Southern University and I am conducting a study on the effectiveness of the Sports, Play, & Active Recreation for kids (SPARK) program in increasing physical activity and improving cardiovascular and musculoskeletal fitness among children and adolescents.

You are being asked to participate in a project that will help me learn about getting fit. We will use the SPARK program to exercise and play fun games. If you agree to help, I will measure your height and weight and keep track of how fit you are. I will have you answer some questions about how exercising makes you feel. I will also ask you about the food you eat everyday. You will see me 4 days a week at the Boys & Girls Club for 1 hour each day.

You do not have to help me with this project. You can stop helping me whenever you want to. If you do not want me to measure you, it is ok. Nothing bad will happen to you if you tell me you do not want to be measured. You can refuse to help me even if your parents have said yes.

None of the teachers or other people at the Boys & Girls Club will see the answers to the questions that I ask you. All of the answers that you give me will be kept in a locked cabinet in a room at Georgia Southern University, and only I, or people helping me, will see your answers. We will take your name off of the answers that you give us, so no one will be able to know which answers were yours.

If you or your parents/guardian have any questions about this form or the project, please call me or my advisor, Dr. Zwald, at 681-5266. Thank you!

If you understand the information above and want to help in the project, please sign your name on the line below:
Yes, I want to help in the project: ________________________________

Child’s Name: ________________________________________________

Investigator’s Signature: ________________________________________

Date: ______________