



*Original Research*

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## **Effects of the Boy Scouts of America Personal Fitness Merit Badge on Cardio-Metabolic Risk, Health Related Fitness and Physical Activity in Adolescent Boys**

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### ABSTRACT

*International Journal of Exercise Science* 10(7): 964-976, 2017. A growing number of adolescents are more sedentary and have fewer formal opportunities to participate in physical activity. With the mounting evidence that sedentary time has a negative impact on cardio-metabolic profiles, health related fitness and physical activity, there is a pressing need to find an affordable adolescent physical activity intervention. One possible intervention that has been overlooked in the past is Boy Scouts of America. There are nearly 900,000 adolescent boys who participate in Boy Scouts in the United States. The purpose of this research study was to evaluate the effect of the Personal Fitness merit badge system on physical activity, health-related fitness, and cardio-metabolic blood profiles in Boy Scouts 11-17 years of age. Participants were fourteen (N = 14) Boy Scouts from the Great Salt Lake Council of the Boy Scouts of America who earned their Personal Fitness merit badge. Classes were held in the Spring of 2016 where boys received the information needed to obtain the merit badge and data were collected. Results from the related-samples Wilcoxon signed rank test showed that the median of differences between VO<sub>2</sub> peak pre-test and post-test scores were statistically significant ( $p = 0.004$ ). However, it also showed that the differences between the Pre-MetS (metabolic syndrome) and Post-MetS scores ( $p = 0.917$ ), average steps taken per day ( $p = 0.317$ ), and BMI ( $p = 0.419$ ) were not statistically significant. In conclusion, the merit badge program had a positive impact on cardiovascular endurance, suggesting this program has potential to improve cardiovascular fitness and should be considered for boys participating in Boy Scouts.

KEY WORDS: PACER, blood pressure, cholesterol, pedometer

### INTRODUCTION

In 2013, the Center for Disease Control and Prevention (CDC) reported that 15% of the United States adolescent population did not participate in at least 60 minutes of physical activity on any day of the week, 33% watched television for three or more hours per school day, and 41% used computers for three or more hours per school day. Additionally, 52% of children and adolescents did not attend physical education (PE) classes in an average school week (8). These

increases in sedentary time and decreases in physical activity opportunities should be alarming for adolescents because sedentary time has been associated with disease risk indicators such as obesity and cardio-metabolic health markers (10, 29). It has been shown that poor metabolic scores may track from adolescence to adulthood, which in turn increases the incidence of cardio-metabolic disease and early morbidity and mortality (13, 2, 18).

The question then becomes, what can be done to improve the downward trend of physical activity? Obesity and/or being overweight has been shown to be the most important modifiable factor in diabetes prevalence, thus decreasing the occurrence of obesity and overweight becomes an important intervention in the prevention of diabetes (21). Recent research suggests that Canadians have much lower diabetes prevalence than Americans due to their higher physical activity levels (28). Additional research has suggested that individuals that are sedentary have worse cardio-metabolic profiles when compared to those who were more active (10). Thus, the need to find an effective, cost efficient physical activity intervention for adolescents that decreases sedentary time is vital to the health of the growing number of American youth.

Many physical activity interventions targeting adolescents have been implemented and evaluated. In 2013, Alberga and colleagues evaluated fifty interventions and created a list of ten practical ideas that may help improve the success of physical activity interventions (1):

1. Physical activity setting is important
2. Being able to choose your trainer or workout partner/group matters
3. Physical activity should be varied and fun
4. Parents/guardians should be included
5. Individual physical and psychosocial characteristics should be accounted for
6. Realistic goals should be set
7. Regular reminders are important
8. Multidisciplinary approach should be used
9. Barriers should be identified early with plans to overcome them
10. Participants should receive an explanation of the benefits of the intervention

It has also been noted that the longer the intervention lasts, the greater the health benefits and the higher the adherence to physical activity practices (27).

Jago and Baranowski (15) reviewed the timing of non-curricular interventions, including school breaks (e.g. recess), active travel, extracurricular activities, and summer day camps for promoting physical activity. They found that, in general, these interventions showed limited success. Many of the interventions failed to increase physical activity and/or reduce body mass index (BMI). It was suggested by the researchers that these interventions could have been improved if they had actively involved parents, focused on setting appropriate goals, advertised the interventions to the potential participants more effectively, and exposed the participants to the intervention for a longer period of time. The interventions that the

researchers in this study found to be successful resulted in increases in habitual physical activity, short-term reduction in weight and long term weight control.

The Boy Scouts of America (BSA) is an untapped community organization that may be used to target physical activity. BSA is a values-based organization that focuses on the development of youth character through a variety of avenues, including personal fitness (5). The typical ages for boys participating in the Scouting program are 11 to 17 years. The biggest accomplishment for a Boy Scout is to earn his Eagle Scout. This task takes years to accomplish and requires the dedication of each Scout to earn all of the required badges. The Personal Fitness merit badge is one of twelve merit badges required to earn the Eagle Scout award. In 2013, there were 888,947 Boy Scouts in the United States, 56,841 earned their Eagle Scout award and 56,295 of them earned their Personal Fitness merit badge; making it the ninth most common merit badge earned by Boy Scouts (5). To date there have only been two studies (16, 20) published that have used the Boy Scouts as participants in physical activity interventions.

The first study examined the effects of a physical activity intervention using troop time and an online program targeting self-efficacy and preference change (16). The research team was given 20 minutes of troop time to lead a physical activity session focused on earning what the researchers called the "Fit for Life" badge; Scouts were encouraged to take what they learned in this session and use it in their daily lives. Although, the intervention did not yield a significant change in minutes of moderate to vigorous physical activity (MVPA), there was, however, a decreasing trend in sedentary time.

The second study involving Boy Scouts evaluated the relationship between goal setting and physical activity behavior change (20). The results showed that physical activity goals of the Boy Scouts did not relate to physical activity because the activity levels, as measured by the accelerometer, did not have significant change (20).

The research team of Seger, Eccles, and Richardson (26) recommended that future goals should focus on outcomes to be achieved from physical activity goals, as this has been shown to help relate goal setting to physical activity behavior change. The results from the aforementioned interventions have shown that both in school and out of school programs can have a positive impact on the fitness and health of adolescents. However, many of the interventions did not change physical activity levels, increase health related fitness, nor did they improve cardio-metabolic profiles.

The purpose of this research study was to evaluate the effects of the Personal Fitness merit badge system on six-day physical activity, health-related fitness, and cardio-metabolic blood profiles in Boy Scouts 11-17 years of age. We hypothesized that the following changes would result from earning the Physical Fitness merit badge:

- 1) Boy Scouts' would show a significant increase in steps taken per day;
- 2) Boy Scouts' health-related fitness levels for cardiovascular endurance, as measured by the Progressive Aerobic Cardiovascular Endurance Run (PACER), would show a significant increase in laps;

3) Boy Scouts' cardio-metabolic profiles would improve in health through significant reduction in BMI, LDL, total cholesterol, waist circumference, fasting blood glucose, and blood pressure, along with significant increases in HDL.

## METHODS

### *Participants*

A convenience sample of fourteen Boy Scouts ages 11 to 17 years old (M=11.93, SD=1.21) from the Great Salt Lake Council of the Boy Scouts of America (Salt Lake County, Utah) participated in a Personal Fitness merit badge class. Boys who participated could not have earned the merit badge previously. All participants were Caucasian. All procedures were approved by both the University Institutional Review Board as well as the local Boy Scouts of America Council. Furthermore, all participants had parental consent and approval prior to the implementation of the study.

### *Protocol*

The Personal Fitness merit badge is one of twelve merit badges required to earn the Eagle Scout award. In order to earn the merit badge, Scouts are required to complete nine intensive steps to improve areas of personal fitness. At the completion of the merit badge, each Scout will have fulfilled the following requirements:

- Receive a physical exam from a pediatrician or family practice doctor
- Provide a detailed definition of and explain the importance of:
  - Mental health
  - Physical health
  - Social health
  - Physical fitness
  - Nutrition
- Identify and learn the importance of:
  - Weight and body composition
  - Healthy and non-healthy habits
  - Appropriate and inappropriate diets
  - Vaccination needs
  - Sleep schedule
  - Typical physical activity and exercise routines
  - Family life
  - Disease potential
- Perform pre- and post-test measurements for aerobic fitness (mile run), strength (pushups and curl-ups), flexibility (sit and reach), and body composition (BMI)
- Create, perform and log a 12-week physical fitness program
- Research three careers that specifically deal with personal fitness

To objectively review the physical activity levels of the participants, a Digiwalker CW600 pedometer was utilized. The Digiwalker CW600 has been found to provide a valid measure of physical activity in adolescents (17). Upon conclusion of the initial merit badge testing, Scouts

were given a pedometer to wear for six consecutive days, from the time they woke up until they went to bed, starting the next day.

The cardio-metabolic profile of each participant was collected using the Cholestech LDX system (Alere Inc., Waltham, MA, USA). The system included measures for total cholesterol (TC), low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides (TRI), and blood glucose (BG). The blood sample was collected in a fasting state on the day of the merit badge class. Both the participant and the parent or guardian were asked for verification of the fasting state. Blood samples were collected using a finger prick on the Scout's right index finger using a 40-uL capillary tube and immediately injected into the Lipid Profile-Glucose Cassette (Alere Inc., Waltham, MA, USA) and subsequently analyzed. The finger was cleansed and bandaged and all materials were properly disposed of in a biohazard container.

Blood pressure measures were identified by using the electronic blood pressure machine, specifically the CONTEC08A (Contec Medical Systems Co.; Qinhuangdao, China). To ensure a resting measure, Scouts had their blood pressure measured prior to performing any fitness testing. Blood pressure standards in adolescents are dependent upon age, sex, and height, and are found in standardized charts (24, 23). Pre-hypertension in adolescents is defined as having a blood pressure between the 90<sup>th</sup> percentile and the 95<sup>th</sup> percentile or having a measure of 120/80 mm HG or greater. Hypertension is defined as having a blood pressure measure greater than the 95<sup>th</sup> percentile (24).

The body mass index (BMI) of the participants was used to measure body composition. BMI was found by taking the Scout's weight in kilograms divided by the square of his height in meters. Height was measured to the nearest 1 centimeter using a portable stadiometer (Seca 213; Hanover, MD, USA). Weight was measured to nearest 0.1 kilogram using a portable medical scale (BD-590; Tokyo, Japan). Waist circumference was measured to the nearest 1 centimeter using a standard tape measure. Height, weight, and waist circumference measures were collected in a private room. Shoes were removed, but clothes remained on for all three measures.

Aerobic fitness was measured through the completion of the FITNESSGRAM PACER. Participants completed as many 20 meter laps as possible. Scouts had to complete each lap prior to a beep. If a Scout failed to complete a lap twice, his test was over. Scores were recorded as total laps. The running took place inside of a gymnasium with hard wood flooring.

The fitness testing and cardio-metabolic profiles for the pretest were collected on the day of the first merit badge class. Post-test data were collected 12-weeks later at the last merit badge class. Pushups, sit-ups, and sit and reach tests have shown weaker relationships to health, therefore they were not used as dependent variables. (11).

The Great Salt Lake Council notified Scout troops via email and face-to-face meetings to ensure that each individual Scout troop was aware of the day of the class. Scouts wishing to earn their Personal Fitness merit badge were asked to be a part of the intervention group.

The control group consisted of Scouts that did not want to earn their Personal Fitness merit badge, yet wished to receive a free health screening, that included health-related fitness scores, blood pressure, BMI, waist circumference, blood lipid levels, and physical activity levels. They, too, attended the merit badge class to receive the screening; however, they did not receive any information about nor did they work on the personal fitness merit badge.

The first class introduced the participants to the Personal Fitness merit badge and established what is required to earn the badge. Participants were tested on the PACER, pushups, curl-ups and flexibility (sit and reach). The height, weight and waist circumference of each Scout was gathered in a private room. The resting blood pressure and a blood lipid finger prick were also taken. As the participants left the first merit badge class, they were given a Digiwalker CW600 pedometer to wear for six consecutive days (starting on the Sunday following the class), excluding showering, swimming, or another activity that could damage the pedometer if worn. At the completion of the six days, participants met again at the location of the merit badge class to turn in their pedometers to the researcher. Also, after the first class, the participants started working on the completion of their individual Personal Fitness merit badges, or went about their normal lives if they were in the control group. The participants did not meet with the research team again until the Personal Fitness merit badge was completed 12-weeks later. At the completion of the 12-weeks, the Scouts returned for the last class where they were again tested and measured. If they have completed the merit badge requirements, the principal investigator signed off that the Personal Fitness merit badge had been earned. Again, as the participants left they were given a Digiwalker CW600 to wear for six more days (beginning on the Sunday after the class). Once the pedometers had been returned, the intervention was completed.

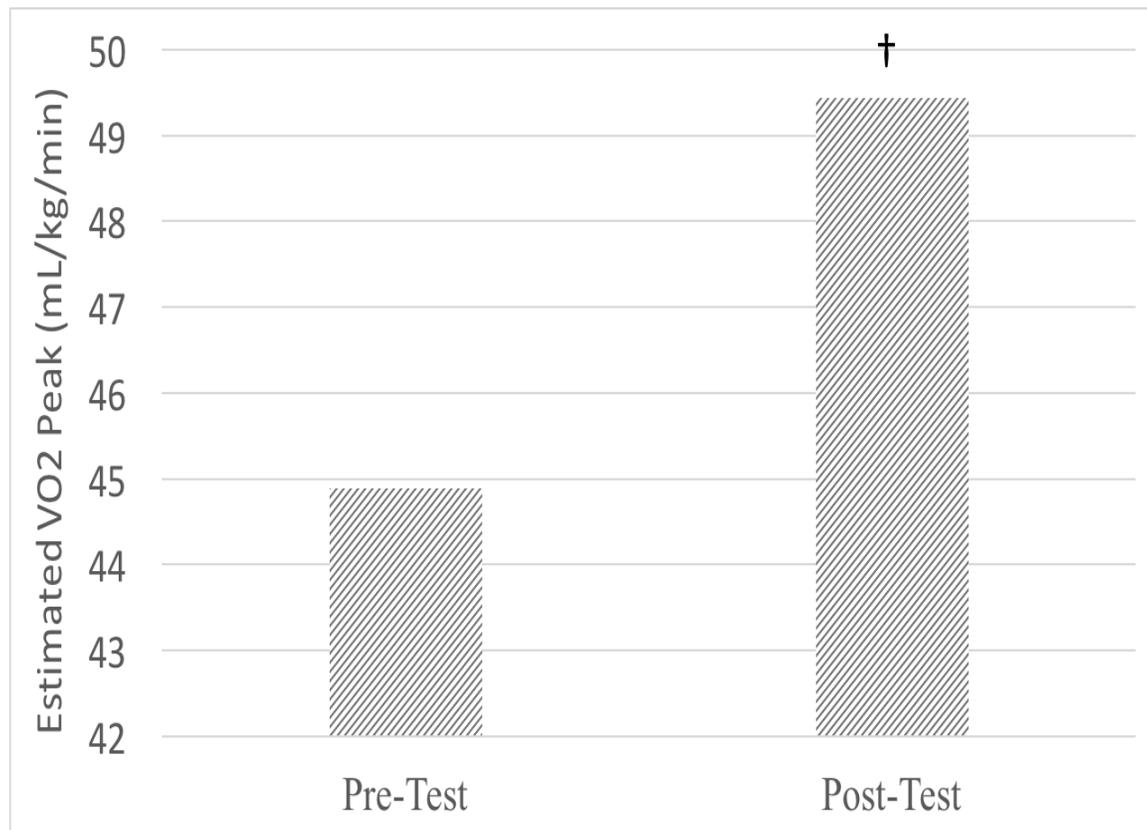
#### *Statistical Analysis*

An a priori power analysis was conducted, which showed that in order to detect a medium sized effect with 80% statistical power and an initial two-sided alpha level of  $p \leq 0.05$ , 34 participants were needed. Because of the small sample size ( $N=14$ ), a non-parametric Wilcoxon Signed Rank test was employed to examine the median differences from pre-test to post-test on all dependent variables. The first dependent variable was an age-adjusted Metabolic Syndrome score (MetS), which is a clustering of biomarkers that has been associated with adolescent health (11). The MetS score was calculated by converting each cardio-metabolic health marker (i.e., HDL cholesterol, triglycerides, blood glucose, mean arterial pressure, and waist circumference) into a standardized residual z-score. Age was regressed onto each health marker and then standardized residuals were calculated. Because HDL cholesterol is inversely related to health risk, the z-score for this parameter was multiplied by -1. The MetS score used for analysis was the sum of the age-adjusted standardized residual z-scores. The second dependent variable was aerobic capacity, as measured using the PACER test and a linear regression equation, using an age covariate to estimate  $VO_2$  peak used by the

FITNESSGRAM testing battery (6). The last dependent variable was BMI. All analyses had an initial alpha level of,  $p \leq 0.05$  and were carried out using the SPSS v21.0 statistical software package (Armonk, NY, USA).

## RESULTS

The related-samples Wilcoxon signed rank test showed that the median of differences between VO<sub>2</sub> peak pre-test and post-test scores were statistically significant ( $p = 0.004$ ; See Figure 1). However, there were no differences between the Pre-MetS and Post-MetS ( $p = 0.917$ ), average-steps taken per day ( $p = 0.317$ ), and BMI ( $p = 0.419$ ). Descriptive statistics for the experimental group are found in Tables 1 and 2.



**Figure 1.** Median Difference Between Pre-VO<sub>2</sub> Peak and Post-VO<sub>2</sub> Peak; † Statistically significant  $p=.0004$ .

**Table 1.** Descriptive statistics for the total sample at pre-test.

	Mean	SD
Age (years)	11.93	1.21
Height (meters)	1.56	0.13
Weight (kilograms)	47.32	12.71
Body Mass Index (kg/m <sup>2</sup> )	18.67	3.31
Waist Circumference (cm)	69.14	8.04
PACER Laps (Laps)	34.14	22.42

**Table 2.** Results pre- and post- merit badge for the primary dependent variables.

	N	Mean	SD
Pre-VO <sub>2</sub> (mL/kg/min)	21	44.88	4.92
Post-VO <sub>2</sub> (mL/kg/min)	14	49.55*	4.97
Pre-BMI (kg/m <sup>2</sup> )	21	18.67	3.31
Post-BMI (kg/m <sup>2</sup> )	14	19.02	3.43
Pre-MetS (z-score)	19	-0.53	3.58
Post-MetS (z-score)	15	-1.14	3.14

\* p&lt;.05

## DISCUSSION

The purpose of this research study was to evaluate the effects of the Personal Fitness merit badge system on six-day physical activity, health-related fitness, and cardio-metabolic blood profiles in Boy Scouts 11-17 years of age. The results showed that estimated VO<sub>2</sub> peak calculated from the PACER displayed significant change from the beginning of the three-month merit badge intervention period to the end of the intervention period (see Figure 1).

This supports the statement by the National Association for Sport and Physical Education (NASPE) that VO<sub>2</sub> peak is the most important element of health-related fitness due to its positive link to cardio-metabolic health (22). One reason for this significant change could be that the Physical Fitness merit badge focuses on running as part of the Scout's personal fitness plan. Running is a physical activity that has cardiovascular benefits, therefore impacting the VO<sub>2</sub> peak of participants. Scouts set specific goals to improve their running times and were asked to check for improvement many times throughout the twelve weeks.

Eisenmann et al. (12) determined that the average, or 50<sup>th</sup> percentile, VO<sub>2</sub> peak for an adolescent boy ranges from 42-46 mL/kg/min depending on age. In the current study, the participants began the merit badge with an average adolescent VO<sub>2</sub> peak of 44.88 mL/kg/min, however, by the completion of the merit badge, Scouts had, on average, increased their VO<sub>2</sub> peak closer to the 75<sup>th</sup> percentile of adolescent boys at 49.55 mL/kg/min.

It is also recognized that the change found in VO<sub>2</sub> peak from the pre-test to the post-test could have simply been due to the participants having natural maturation and growth. Thus, the results may not have been due to the merit badge itself, but rather due to the participants becoming more physically mature. However, that much maturation in a twelve-week period is not as likely. Also, the calculation of VO<sub>2</sub> peak requires age to be input into the validated regression model, therefore age was controlled for in the analysis. In addition, the participants could have taken the PACER test in physical education class at school, thus familiarizing them

with the test and allowing them to perform better due to having more opportunities to practice.

The results showed that there was not a significant change between the pre- and post-test for the age-adjusted MetS scores. One possible reason for this could be because the intervention period of three months was not long enough. Another study similar to this one also found that there was no significant change in the cardio-metabolic profiles of its intervention participants and it to was 12-weeks long (14). Some studies have shown that physical activity interventions, like the merit badge, have improved metabolic profiles; however, they were all longer than three months (19, 3, 9). In order to see changes in metabolic profiles, the merit badge would have to occur over the course of about 6-12 months, which is probably feasible for the Boy Scouts of America.

Similar to the lack of change in the MetS score, there was no significant difference in BMI from pre-test to post-test. Again, one reason could be because the intervention period was not long enough. The MSPAN study, which lasted 33 months (21 months longer than this study), found significant change in BMI over time (25). This provides evidence that a longer physical activity intervention can have an effect on BMI. Another reason for the lack of change in BMI could be due to the weight status of the participants. It has been found that BMI changes are stronger in overweight populations (4). This cohort of Scouts had an average BMI of 19; which is categorized as healthy weight according to the CDC (7).

Another reason for the lack of changes in MetS scores and BMI could be because the merit badge focuses on physical activity, but with little emphasis placed on nutrition. What the Scouts eat can be just as important as the amount of activity they are participating in on a daily basis. If a Scout is eating more calories, than his BMI measures could be negatively impacted.

All Scouts should be encouraged to participate and earn the Personal Fitness merit badge even if they are not striving to earn their Eagle Scout. The merit badge could also be used in schools as a project to be completed in a physical education class. It even has the potential to be used by pediatricians as a way to improve cardiovascular fitness of adolescent patients who are showing signs of increased disease risk. In athletics, a coach could recommend his/her athletes use the merit badge as an offseason conditioning program to improve aerobic capacity. However, additional research would be needed in these areas to determine the effectiveness of the merit badge.

Many of the studies presented earlier also reported limited success in health-related results. It appears that many interventions, like this one, tend to see one or two significant areas of change and other areas of little or no change. It is recommended that in the future, researchers create or adapt interventions that follow the ten guidelines presented by Alberga et al. as closely as possible, as these have been shown to be essential for changing behavior. The list below marks the Alberga et al. guidelines (1) that were met by the Personal Fitness merit badge with a check and the guidelines that were not met with an empty circle:

- Physical activity setting is important

- Being able to choose your trainer or workout partner/group matters
- Physical activity should be varied and fun
- ✓ Parents-guardians should be included
- Individual physical and psychosocial characteristics should be accounted for
- ✓ Realistic goals should be set
- ✓ Regular reminders are important
- Multidisciplinary approach should be used
- Barriers should be identified early in the process with plans to overcome them
- ✓ Participants should receive an explanation of the benefits of the intervention

Perhaps a reason for the limited amount of change after the merit badge is that not more of the recommendations were met. It is the recommendation of the researchers that the Personal Fitness merit badge be adapted to address all of these recommendations so that more changes occur, beyond just improvement in VO<sub>2</sub> peak.

The power analysis revealed that at least 15 participants were required to be a part of the experimental group and at least 15 to be a part of the control group. Only six participants were in the control group, therefore, the power was not strong enough to compare groups. Also, due to the timing of the study, no follow-ups occurred after the 12-week intervention. The results may not translate to other ethnicities, ages, or genders, as the only participants were Caucasian adolescent boys.

It is recommended that the study be repeated with the appropriate amount of participants in both the experimental and the control groups. To do this, it is recommended that researchers recruit as many individual Scout troops as possible instead of organizing through Scouting districts. This will take more time, but should produce better results. Schools could be used to recruit control participants. To measure how well the merit badge expectations were followed, surveys could be given to Scout leaders and parents. Potential questions could include: How often did you talk about the merit badge? Was the merit badge talked about weekly? Biweekly? Monthly? Did you examine and help the Scout create his workout plan? What type of support did you provide the Scout during the process? Follow-up interviews or surveys should be conducted 3 to 12 months after the completion of the merit badge to see if the changes were temporary or more permanent. Considerations should be made to adapt the merit badge to align more fully with an effective physical activity intervention as presented by Alberga et al. (1). These steps are consistently present in effective interventions and programs. Perhaps the merit badge intervention period should be increased as longer time periods are needed to see change in fitness and metabolic syndrome scores. The merit badge could also be studied in a physical education class where both boys and girls are applying the principles of the badge.

Our overall findings for each of the hypotheses suggest:

- 1) Physical activity as measured by the pedometer, did not have a significant increase over time, thus the null hypothesis is retained.

- 2) Cardiovascular endurance as measured through the PACER test and configured to find a VO<sub>2</sub> peak, saw a significant increase over time, thus the null hypothesis is rejected. BMI did not significantly change, thus the null hypothesis was not rejected.
- 3) The MetS score did not have significant change, thus the null hypothesis was not rejected.

In conclusion, the Physical Fitness merit badge did have an impact on cardiovascular endurance of the participants who earned the merit badge. While improvements in other areas of health-related fitness may be lacking, the idea that VO<sub>2</sub> peak was significantly improved shows that the merit badge can and should be used as a physical activity intervention. If desired, the Boy Scouts of America could work to improve the merit badge to include other aspects of health, such as physical activity, cardio-metabolic profiles, and BMI.

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