

## FITNESS

# A Comparison of the Fitness, Obesity, and Physical Activity Levels of High School Physical Education Students Across Race and Gender

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## Abstract

**Introduction:** Little is known about the physical fitness, obesity, and physical activity (PA) levels of high school students in physical education classes when comparing racial and gender groups. **Purpose:** To compare the fitness, obesity, and PA levels of female and male students of different racial groups in 6 high schools in the southeastern United States. **Methods:** Three fitness measures (PACER, Modified Curl-Ups, and the Back-Saver Sit and Reach), as well as BMI, body fat percentage, and PA data, were obtained from 413 youth (216 females, 197 males,  $14.8 \pm .84$  years). Additionally, fitness levels, prevalence of obesity, and PA patterns of genders and races were compared between groups. **Results:** Fitness, body fat, and PA data were significantly better for males than for females other than back-saver sit and reach, for which females performed higher. There were no gender differences in BMI. White students scored significantly better than Black students on fitness, body fat, PA, and BMI except back-saver sit and reach right side. **Conclusions:** The study suggests a strong need for more active

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*physical education programs that are appropriate for developing the fitness and PA levels of high school students, especially females and Black students, and for programs that motivate students to improve their fitness and PA levels beyond and outside of high school.*

The need to improve physical fitness in school-aged children in the United States has received considerable attention ever since Kraus and Hirschland (1954) indicated that American children were less fit than European children. Concern for the health-related physical fitness of all children in American schools has recently increased because of the current childhood obesity epidemic. The benefits of physical fitness are universal for all children and can potentially improve students' academic performance, including academic achievement and grades, time on task, concentration, and attentiveness (Centers for Disease Control and Prevention [CDC], 2013).

Children and adolescents who are obese are more likely to be obese as adults (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001). The rate of obesity in adolescents has nearly quadrupled (from 5% to 21%) over the past 30 years (CDC, 2012). The rise in overweight and obesity in adolescents has also given rise to the likelihood of having major health problems, such as type 2 diabetes, cancer, and greater risk for bone and joint problems (U.S. Department of Health and Human Services [USDHHS], 2010). Many adolescents also exhibit early signs of cardiovascular risk factors, such as physical inactivity, excess weight, and higher blood cholesterol levels (Beets & Pitetti, 2004). In contrast to these physical risk factors, obesity also exerts a social and psychological burden on adolescents—the likelihood of a low quality of life for obese adolescents is 5.5 times greater than for their healthy weight counterparts (Schwimmer, Burwinkle, & Varni, 2003).

The school physical education (PE) curriculum is the primary source of physical activity (PA) and fitness instruction for adolescents (USDHHS, 2001). It has been suggested that the quantity and, in particular, the quality of school PE have a significant positive effect on the health-related fitness of adolescents by increasing their participation in moderate to vigorous physical activities (McKenzie et al., 1996). High quality PE gives adolescents the opportunity to learn the fundamental movement skills needed to establish and maintain physically active lifestyles throughout their lives. States

and local school districts determine the amount of required PE that children and adolescents receive daily. In 2006, few schools provided daily PE or its equivalent for the entire school year to all students (Lee, Burgeson, Fulton, & Spain, 2007). Across the nation in 2007, only 30% of high school students attended PE classes for 5 days in an average school week compared with 42% in 1991 (CDC, 2008). To promote PA and its resulting benefits, school systems should require at least 225 min/week of required daily PE in all secondary schools. Sedentary behavior in adolescents may be influenced by insufficient motor or physical fitness because competence in movement is crucial to activity participation (Okely, Booth, & Chey, 2004). Because having higher levels of physical fitness is important to the functional health needed for everyday living and for preventing disease and obesity, attempts should be made to evaluate the physical fitness of high school students.

It has been consistently reported that adolescent males participate in PA more than adolescent females do (Fakhouri et al., 2014). Wenthe, Janz, and Levy (2009) in a study of 205 adolescents found that male adolescents spent a greater percentage of their day engaged in moderate to vigorous physical activity (MVPA), performed a higher number of 5-min bouts of MVPA, and reported more MVPA than did their female counterparts. In a study of 5,863 students over 5 years, Brodersen, Steptoe, Boniface, and Wardle (2007) found that, on average, adolescent males exercised approximately one day per week more than females ( $p < .001$ ).

There have been numerous efforts to study the differences in fitness, obesity, and PA between male and female adolescents (Hannon & Ratliffe, 2005), but few researchers have compared these physical components between students of different ethnicities. Kimm et al. (2002) examined longitudinal changes in PA in a large cohort of over 2,000 Black and White adolescent females over 10 years. Throughout the study, Black females had significantly higher BMI values, with Black females having a decline in PA twice that of White females. Brodersen et al. (2007) also found that sedentary behavior was more common in Black students than in White students and that Black females engaged in less PA than did White females, with these differences persisting over several years. Both groups decreased PA over time.

The primary goals of this study were to assess the fitness, obesity, and PA levels of adolescents in high school PE classes and to determine any relationship between these levels across race and gender. We sought to answer the following two questions: (a) What are the differences in fitness, obesity, and PA levels of a selected group of male and female high school students, aged 14–16? (b) What are the differences in these levels of the same group according to racial group identification?

## Method

### Participants

A total of 413 high school students (197 males, 216 females,  $14.8 \pm .84$  years) from six southeastern high schools participated in this study. Of the students, 171 were Black, 186 were White, 29 were Hispanic, and 27 were multiracial or from other ethnic groups. Students were allowed to self-identify their ethnicity, which is a common practice in obtaining census data (U.S. Census Bureau, 2013) and for school demographics (Fahlman, Hall, & Lock, 2006). The 413 participants in this study were representative of the population in any high school PE class in the school district. Participants were enrolled in one of 21 required ninth grade PE classes throughout the six schools. Informed parental consent, along with district and school administration approval, was obtained before participation in the study. The study was approved by the university institutional review board.

The 21 high school classes were randomly selected from the available PE classes in all high schools of the district. Participants were from six high schools (Grades 9–12) of approximately 1,500 students each. The sample design was purposive in that the participants had to be enrolled in a ninth grade PE class and they could not have any limiting physical condition that would hinder their ability to engage in routine PA. The 21 PE classes contained an average of 19 students (range = 10–27 students) in each class. When parental consent was not granted ( $N = 4$ , or .01%), those students were given an alternative assignment during the class.

In all six settings, students received PE from a licensed physical educator 5 days per week, all having block periods of 90 min. During class instructional activities in PE, the curriculum involved

games, fitness, and physical activities that were focused on continuous activity and skill improvement.

## **Data Collection**

Data collection was conducted during a 12-week period during the second semester of the school year. One of the physical educators at each school assisted the research team with data collection. The research team consisted of one senior researcher and six graduate students who were trained in the assessment protocols. Testing was conducted in a gymnasium in all six schools, and school visits for testing occurred over 14 weeks.

There are numerous tests and test batteries to measure the five components of physical fitness, but FitnessGram is used most often in PE classes (Meredith & Welk, 2010). The five testing items used in this study were selected because of their roles as important indicators of health-related fitness. The measures included (a) BMI to indicate the prevalence of obesity, (b) percentage of body fat as measured by a bioelectrical impedance scale, (c) the 20-m Progressive Aerobic Cardiovascular Endurance Run (PACER) to measure cardiovascular endurance, (d) the modified curl-up test of abdominal strength and endurance, and (e) the back-saver sit-and-reach (BSSR) test to measure flexibility. The use of FitnessGram as a fitness assessment in schools is supported by the FitnessGram Scientific Advisory Board (Meredith & Welk, 2010).

In addition to the fitness testing and obesity measures, the PA patterns during PE classes were determined through the use of pedometers to measure step counts. A pedometer is an objective measure of step counts to determine individual PA levels, and it is considered one of the most widely used practical PA measures in exercise and PA interventions (Tudor-Locke, Hatano, Pangrazi, & Kang, 2008). An Omron pedometer (model HJ-112) with a 7-day memory function was given to each student at the beginning of each PE class to assess the students' PA levels during their PE classes. The pedometer was placed on the waistband of their required PE uniforms on the right side of the body. The pedometers were immediately retrieved when the PE class period was completed, and the step count was immediately recorded for each student by one of the researchers. The students' average pedometer step count per day was used for the analysis of the PA component. The pedometer testing was recorded

for 5 consecutive days, but the middle 3 days of step counts were used to determine the average number of steps per student.

**BMI.** BMI provides an indication of the appropriateness of a child's weight relative to height. BMI is usually calculated from height and weight data and is derived from the following equation:

$$\text{BMI} = \text{body weight (kg)} / \text{height}^2 \text{ (m)}$$

Estimates of obesity level based on height and weight (BMI) result in an acceptable level of 5% to 6% error because body weight reflects muscle and bone mass as well as fat mass (Lohman, 1981). Standing height (cm) was measured without shoes to the nearest 0.1 cm using a portable stadiometer (Model 214, range: 20–200 cm; Seca, Hamburg, Germany). Body weight (kg) was measured to the nearest 0.1 kg using a digital weight scale (Model DG-66, maximum: 150 kg; Seca, Hamburg, Germany). Participants' ages were calculated by subtracting their date of birth from the date of assessment using the Weill Medical College of Cornell University age calculator for pediatric medicine (Pon, 2009). Age-specific BMI values were calculated using the CDC's BMI Calculator for Child and Teen (National Center for Health Statistics, 2010). "The reliability of BMI is very high because the measurement of height and weight is very precise when following a standardized protocol" (Lohman, 1994, p. 59).

**Body composition.** The percentage of body fat for each student was measured using the Omron (model HBF-400) leg-to-leg bioelectrical impedance scale. It has often been theorized that these segmental devices for measuring body fat percentage are not reliable instruments. However, in a study on the accuracy of consumer grade bioelectrical impedance analysis (BIA) devices, the leg-to-leg BIA devices were found to provide an acceptable significant correlation with weight changes over time, but they may not be accurate enough to give reliable individual body composition measures (Peterson, Repovich, & Parascand, 2011). In other studies, it has been suggested that segmental BIA provides a relatively accurate estimate of body composition in high school students (Kriemler et al., 2009; Lintsi, Kaarma, & Kull, 2004).

**PACER.** The 20-m PACER test (Meredith & Welk, 2010) is a multistage aerobic capacity fitness test adapted from the 20-m

shuttle-run test. For this study, eight to 10 students were tested during each round of PACER testing, and each student being assessed had an assigned partner to record the number of laps. Cones were set at a starting line and at a distance of 20 m from the starting line for each student. One lap was counted for every 20-m distance covered. The test was concluded when the participant could no longer complete a 20-m lap. According to Meredith and Welk (2010), the PACER test has demonstrated reliability and validity measured against maximal oxygen uptake ( $VO_2$  max), which is generally considered the best measure of aerobic capacity.

**Modified curl-up.** The modified curl-up was used to measure abdominal strength and endurance. The modified curl-up was performed with the participants' knees flexed and their feet unanchored. The students were instructed to place their hands at the top of a 4-in. rubber strip taped to the mat underneath them and to slide their fingers to the other side of the rubber strip, which counted as one modified curl-up. This test was selected for use in this study because of its high reliability and validity. The intraclass coefficients ( $R$ ) for the modified curl-up range from .93 to .97 (Robertson & Magnusdottir, 1987).

**Back-saver sit and reach (BSSR).** Flexibility and range of motion are measures that describe attributes of motion within the body. The BSSR was included in the FitnessGram battery in response to the health-related concern of low back pain. The BSSR is similar to the traditional sit-and-reach test, except that the measurement is performed on one side at a time. In this study, BSSR was tested three times on the left side and three times on the right side. The highest score on each side was used in the data analysis because it likely best represents a student's true flexibility and range of motion. The advantage of the BSSR is that by testing one leg at a time, any asymmetry in hamstring flexibility can be identified with acceptable accuracy (Meredith & Welk, 2010). An intraclass reliability of .99 was reported for the BSSR (Patterson, Wiksten, Ray, Flanders, & Sanphy, 1996). A student was considered as having met the minimum FitnessGram standards if he or she reached the standard on either the left side or the right side or on both sides.

## Data Analysis

Data were analyzed using IBM SPSS 19 (IBM Corporation, Armonk, NY) to compare high school students by gender and race regarding their performance on each of the five fitness/obesity measures and the pedometer step counts. To investigate if the observed differences between groups were statistically significant, an independent *t* test was conducted and the alpha level was set at  $p < .05$ . For the differences by gender, all 413 students were included in the analysis. For the analysis by race/ethnicity, only White ( $n = 186$ ) and Black students ( $n = 171$ ) were included, for a total of 357 students. Students who classified themselves as Hispanic ( $n = 29$ ) or Multiracial/Other ( $n = 27$ ) were not included because of a very small sample size for each group. Including these groups would have violated the mathematical assumptions for parametric statistics as well as reduced internal validity.

## Results

The main concerns by gender for this population of ninth grade students were in the areas of body composition for females and the lack of cardiovascular fitness for males and females. The average BMI of the male students was 23.46, and the average BMI of the female students was 24.23; both values are closer to the heavier end of the Healthy Fitness Zone, based on the FitnessGram standards (Cooper Institute, 2013). The average body composition value for the ninth grade males was 16.17 and for the females was 31.24. This body composition mean for the males was considered Very Lean by FitnessGram standards and for the females was considered in the Needs Improvement-Health Risk category for this age group. The average number of PACER laps for the males was 39.25 and for the females was 20.49, and both values are clearly below the Needs Improvement zone of FitnessGram. These data show an overall lack of cardiovascular endurance among all participants in the study. The mean number of modified curl-ups for males was 49.47 and for females was 41.20, both clearly exceeding the minimum modified curl-up standards for FitnessGram. The mean BSSR (right and left side) values for the males and females exceeded the minimum standards for FitnessGram. The step count means for males and females fell well below the expected step counts for MVPA during a 90-min

period, especially for young adults. The low step counts reflected a large amount of wait time and disorganized lessons on the part of the physical educators in the 21 PE classes studied. A positive result of these findings is the exceptional flexibility and abdominal strength shown by both genders.

Student data were compared to test for differences by gender and by race in fitness, PA, body composition, and prevalence of obesity. The results for the comparison between males ( $n = 197$ ) and females ( $n = 216$ ) are reported in Table 1. As found in most other research, the males ran more laps on the PACER test ( $M = 39.25, p < .0001$ ), performed more curl-ups ( $M = 49.47, p < .001$ ), had higher step counts in the PE classes ( $M = 2,409, p < .0001$ ), and had lower body fat percentage ( $M = 16.17, p < .0001$ ) than did the females. As expected, the females had higher flexibility on both the right side ( $M = 35.35, p < .0001$ ) and the left side ( $M = 36.06, p < .0001$ ). There was no significant difference between genders on BMI calculations, which is a valid indicator of the prevalence of obesity (Hannon, Ratliffe, & Williams, 2006). However, there was a significant difference between genders in their body composition data. The bioimpedance analysis device used to measure body composition for participants in this study has not been shown to be a valid measurement of body composition. The lack of difference between genders on the BMI measurement may indicate that the prevalence of obesity is similar between genders in this sample.

**Table 1**

*Student Fitness, Obesity, Physical Activity Levels by Gender*  
( $n = 413$ )

Measure by gender	<i>M</i>	<i>SD</i>	<i>df</i>	<i>p</i>
PACER				
Male	39.25	20.63	411	.000***
Female	20.49	10.78		
Modified Curl-Up				
Male	49.47	25.22	411	.001**
Female	41.20	24.13		

**Table 1 (cont.)**

Measure by gender	<i>M</i>	<i>SD</i>	<i>df</i>	<i>p</i>
Sit & Reach (Right)				
Male	29.66	7.84	411	.000***
Female	35.35	7.35		
Sit & Reach (Left)				
Male	29.67	7.48	411	.000***
Female	36.06	7.08		
Pedometer Steps				
Male	2409.70	1095.40	411	.000***
Female	1852.11	903.73		
BMI				
Male	23.46	5.42	411	.153
Female	24.23	5.60		
Percent Body Fat				
Male	16.17	9.65	411	.000***
Female	31.24	10.39		

\*\* $p < .01$ . \*\*\* $p < .001$ .

In regard to racial groups, data were only compared between Black students ( $n = 171$ ) and White students ( $n = 186$ ). The right side sit-and-reach results were the only nonsignificant finding, likely because the difference between groups was very small on this test. White students ran more laps on the PACER test ( $M = 31.31$ ,  $p < .04$ ), performed more modified curl-ups ( $M = 49.28$ ,  $p < .006$ ), had higher step counts ( $M = 2,288$ ,  $p < .007$ ), and had a slightly lower BMI ( $M = 23.07$ ,  $p < .043$ ) and percentage of body fat ( $M = 22.06$ ,  $p < .036$ ). Black students had a significantly higher flexibility on the left side ( $M = 34.04$ ,  $p < .002$ ).

**Table 2***Student Fitness, Obesity, and Physical Activity Levels Compared by Ethnicity (n = 357)*

Measures by race	<i>M</i>	<i>SD</i>	<i>df</i>	<i>p</i>
PACER				
Black	28.16	.91	355	.04*
White	31.31	.76		
Modified Curl-Up				
Black	41.89	24.44	355	.006**
White	49.28	25.69		
Sit & Reach (Right)				
Black	33.34	7.25	355	.051
White	31.69	8.57		
Sit & Reach (Left)				
Black	34.04	7.14	355	.002**
White	31.55	8.19		
Pedometer Steps				
Black	1994.42	1014.32	355	.007**
White	2288.46	1027.36		
BMI				
Black	24.23	5.76	355	.043*
White	23.07	5.04		
Percent Body Fat				
Black	24.84	13.60	355	.036*
White	22.06	11.32		

\**p* < .05. \*\**p* < .01.

## Discussion

The results of this study suggest that the adolescent students enrolled in required ninth grade PE classes in this district have a higher incidence of overweight/obesity and lower levels of cardiovascular endurance. Male students performed significantly better in most areas of fitness than females, and White students performed

significantly better in most fitness areas and in step counts than did Black students. Unfortunately, the results of this study lack generalization to other locations. That is, schools that have different teacher-to-student ratios or less time in PE may experience different results for physical fitness levels in high school students of both genders and all races. Given the same amount of PE class time (90 min) for both races, the higher average step count for White students seems perplexing. The differences between races on these fitness, obesity, and PA levels may reflect the lack of opportunity or access to fitness facilities or to organized PA programs.

These findings support previous research on both gender and ethnic comparisons of fitness. Saab, Fitzpatrick, Lai, and McCalla (2011) found that White non-Hispanics had lower odds of obesity and elevated BMI than did Black and White Hispanic students. Black American adolescent females displayed higher odds of obesity and elevated BMI than did Black Hispanic adolescent females and higher odds of elevated BMI than did Black Caribbean adolescent females in this study's sample. Black American adolescent males showed higher odds of obesity and elevated BMI than did Black Caribbean adolescent males. Black Hispanic adolescent females had greater odds of obesity and elevated BMI than did White Hispanic adolescent females. In a study of 198 high school adolescents enrolled in PE courses at a high school in the southeastern United States, White and Black males had equal values for BMI, but White females had a 2.3% lower BMI than did Black females (Hannon et al., 2006). They followed up with skinfold caliper and bioelectrical impedance analysis, which confirmed the differences in body composition between White females and Black females.

One potential limiting factor of this study was the "dropout rate" ( $N = 4$ , or .01%) from the original pool of participants. The parents of several students at each school did not sign the informed consent because of their desire for their children "not to be studied" in the research project. These students participated in PE by engaging in alternative assignments. Even though the remaining sample was highly reflective of the overall population of high school students in this school system, this could have negatively affected the results. Another potential limiting factor was the difference in curriculum and instruction between the six high schools. At a few schools, the

curriculum could be described as “recreational team sports” in content as compared to a “lifetime activity” curriculum offered at the other high schools. There may have been differences in teachers’ instructional styles between classes and between schools as some content and teaching styles elicit more or less PA than other teaching styles. These factors would affect the amount of PA that students experience in their PE classes.

The findings of this study point to an alarming reality that there is a need to promote fitness programs among high school students, especially White females and Black students. The first step in addressing the problem could be identifying the factors contributing to the low fitness levels among high school students. Researchers need to interrogate closely and critically the structures, processes, and practices involved that may obstruct adolescents’ participation in programs that promote physical fitness and PA. Some of those probable contributing factors may be time availability, parents’ involvement, students’ motivation to participate, a lack of staff development, and the availability of PE and PA programs that are suitable, feasible, and sustainable for high school students (Beets & Pitetti, 2004; Fahlman et al., 2006; Felton et al., 2002; Hannon & Ratliffe, 2005). The findings from this study could also be useful as a basis for developing school-based fitness programs (or interventions) uniquely appropriate for meeting the physical needs, as well as the cognitive and social needs, of students in high school PE classes. Other PA factors, such as the built environment regarding access and availability of healthy foods and the availability of parks, bike routes, and walking paths or trails, could be examined in this population.

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