

South Carolina FitnessGram

School Year 2016-2017

FITNESSGRAM[®]
The Cooper Institute[®]



The BlueCross BlueShield of South Carolina Foundation is an independent licensee of the Blue Cross and Blue Shield Association.

Table of Contents

	<u>Page</u>
Introduction	3
South Carolina FitnessGram	5
Project Description	5
Data Collection and Management	5
Data Cleaning	5
Analytic Sample	5
FitnessGram Results	7
Weight Status	7
Cardiorespiratory Fitness	14
Upper Body Strength	21
Abdominal Muscular Strength and Endurance	28
Trunk Extensor Strength and Endurance	35
Flexibility	42
Appendix	49

Introduction

Physical fitness and health in children and youth. The term physical fitness has been defined as “the ability to perform daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and meet unforeseen emergencies.” Physical fitness is typically operationalized as the composite of several components, each of which relates to the ability to perform a specific type of physical activity. A sub-set of these components comprises “health-related physical fitness,” and these include cardiorespiratory endurance, muscular strength and endurance, flexibility and weight status. In children and youth, the components of health-related physical fitness have been linked to short and long-term health outcomes. FitnessGram is a physical fitness testing protocol that is widely used in schools across the United States. Included in the FitnessGram test are measures of each of the components of health-related physical fitness. For each test item, criterion-referenced standards have been established and individual test performances are rated as corresponding to the following categories: Healthy Fitness Zone, Needs Improvement, or Needs Improvement – Health Risk.

Weight status and health in children and youth. In the context of public health surveillance, weight status is typically assessed using body mass index (BMI), an expression of the ratio between weight and height. In children and youth, weight status is evaluated as the age/sex-specific BMI percentile. Children and youth found to be over the 85th percentile for their age/sex group are considered overweight, and those over the 95th percentile are rated as obese. It has been extensively documented that young persons who are overweight or obese, as compared with their normal weight counterparts, manifest less favorable cardiometabolic risk factor profiles, are more likely to be overweight as adults, and are at increased risk for future development of multiple non-communicable diseases. Over the past three decades the rates of overweight and obesity in U.S. children and youth have increased dramatically. Consequently, prevention of excessive weight gain during childhood and adolescence has become an important public health goal. In the FitnessGram protocol, weight status is assessed using BMI which is placed in the following categories: Healthy Fitness Zone (normal weight), Needs Improvement (overweight), and Needs Improvement – Health Risk (obese).

Fitness, weight status and academic performance in children and youth. A substantial and growing body of evidence indicates that physical activity exerts a positive effect on cognition and learning in children and youth. This research has been conducted using many different study designs and methodologies. Neuroscience research has demonstrated that physical activity produces beneficial effects on brain function, and field research has observed that increased physical activity exerts positive effects on student learning. Several studies have observed positive associations between children's physical fitness and their academic performance. Because a major goal of schools is to promote students' academic achievement, the observation that physical activity during the school day can promote learning has important implications for school policy and practices.

Poverty status and health in children and youth. Poverty and low socio-economic status have a negative impact on child and adolescent health during the developmental years and later in adulthood. Multiple studies reveal that higher percentages of children living in low-income families or neighborhoods were overweight or obese when compared to children who were not living in low-income families. Low socioeconomic status neighborhoods are more likely to lack safe playgrounds and parks and to have fewer children participating in organized sports due to a lack of facilities and/or personal resources, all of which represent barriers to maintaining a healthy body weight.

Purpose of the project. The South Carolina FitnessGram project is supported by the Blue Cross Blue Shield of South Carolina Foundation, the South Carolina Department of Health and Environmental Control, and the South Carolina Department of Education. The University of South Carolina serves as the data analysis center for the project. The primary purpose of the project is to evaluate the status of health-related physical fitness in South Carolina school children.

South Carolina FitnessGram

Project Description. The South Carolina (SC) FitnessGram project is a state-wide observational study to evaluate and ultimately improve health-related fitness among approximately 740,000 public school students in South Carolina. Its primary purpose is to capture health-related fitness data from public schools across the state. The findings from this project will be used to support planning and implementation of evidence-based programs and policies to improve health-related fitness. All SC public schools serving grades K-12 were eligible to participate in the SC FitnessGram project. Each school was asked to conduct fitness testing and record health-related fitness data for students enrolled in physical education class. Physical education teachers implemented six fitness test items in grades 5, 8 and in the high school physical education course required for graduation. Height and weight only was measured for second grade students.

Data Collection & Management. During school year 2016-2017, FitnessGram data was provided by nearly 700 public schools across 60 school districts in South Carolina. These samples represent approximately 56% of public schools and 58% of school districts in South Carolina. In participating schools, the FitnessGram was administered by school staff (e.g., physical education teacher) during physical education class. Prior to administration of the FitnessGram test items, school staff received training support through the President's Youth Fitness Program. Staff reported students' performance on the FitnessGram components using a web-based version of the FitnessGram software. All data were loaded into the SC FitnessGram state system and a de-identified research extract file was downloaded by the SC Department of Education (SCDE). The University of South Carolina received de-identified student data from the SCDE to assess health-related fitness among South Carolina students.

Data Cleaning. The initial dataset provided from SCDE included 364,343 unique entries. During the data cleaning process, the sample was reduced to the first measurement for 2nd, 5th, 8th, and 9th-12th grade students with FitnessGram data. Specifically, 50,267 entries were removed due to missing FitnessGram data and 59,399 duplicate measurements for students were removed; yielding a sample of 109,689. Finally, implausible values for age (n=814), body mass index (n=480), cardiorespiratory fitness (n=25), and the remaining FitnessGram components (n=20) were removed; yielding a final sample size of 108,875 students.

Analytic Sample. Table 1 provides student characteristics for the FitnessGram sample during school year 2016-2017. The sample was 51.2% male, 53.2% non-Hispanic White, and 36.6% of students were classified as overweight or obese. Additionally, the proportion of students across regions of SC varied considerably (Appendix A).

Table 1. South Carolina FitnessGram sample characteristics (n=108,875 children).

	Girls (n=53,145)		Boys (n=55,730)		Total (n=108,875)	
	n	Percent	n	Percent	n	Percent
Grade						
2	14,930	28.1%	15,237	27.3%	30,167	27.7%
5	18,570	34.9%	18,713	33.6%	37,283	34.2%
8	10,854	20.4%	11,902	21.4%	22,756	20.9%
High School	8,791	16.5%	9,878	17.7%	18,669	17.1%
Weight Status						
Normal weight	29,031	62.7%	31,457	60.2%	60,488	63.5%
Overweight	7,980	17.2%	7,607	15.5%	15,587	16.4%
Obese	9,293	20.1%	9,922	20.3%	19,215	20.2%
Race/ethnicity						
White	28,093	52.9%	29,775	53.4%	57,868	53.2%
Black	16,479	31.0%	16,856	30.3%	33,335	30.6%
Hispanic	5,100	9.6%	5,600	10.1%	10,700	9.8%
Other	2,126	4.0%	2,072	3.7%	4,198	3.9%
Poverty Status ^a						
No	22,168	42.0%	23,851	43.1%	46,019	42.5%
Yes	30,664	58.0%	31,455	56.9%	62,209	57.5%

^a Poverty status defined as student enrollment in Medicaid, Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), Foster Care Services within the past three years (February 2014 to January 2017); and/or student homelessness/migrant status during school year 2016-2017. Data sources: PowerSchool, Medicaid Eligibility, and DSS (TANF, SNAP, and Foster Care) files at day 135 of school year 2016-2017.

Results by FitnessGram Component

1. Weight Status

Definition. Weight status is typically determined as the ratio between body weight and height expressed in categories based on the distribution of scores seen in a population. A common expression of weight status is body mass index (BMI) expressed in categories: normal weight, overweight or obese. In large samples, BMI is highly correlated with body composition. Body composition refers to the ratio between fat mass and fat free mass, the so-called “percent body fat.” Accordingly, persons who are overweight or obese, based on assessment of BMI, typically have higher percentages of body fat than persons in the normal weight category.

Relationship to health. Maintenance of normal weight is an important indicator of good health in persons of all ages. Conversely, elevated levels of body weight and fatness are associated with increased risk for development of non-communicable diseases including cardiovascular disease, type 2 diabetes, and several cancers. In children and adolescents, overweight and obesity are associated with adverse status for cardiometabolic risk factors such as blood pressure, blood lipids and insulin sensitivity. In addition, in youth, excessive weight and fatness can negatively affect physical function and can have adverse psychological and social effects.

Measures. In the FitnessGram protocol, weight status was assessed using body mass index (BMI). To determine BMI, trained school staff measured height and weight. BMI was then calculated using the following standard equation: $BMI = \text{weight (kg)} / \text{height (m}^2\text{)}$. For youth, BMI is typically reported as a percentile (range: 0-100) relative to other individuals of the same sex and age.

Variable for analysis. Using CDC growth charts, each student’s age- and sex-specific BMI percentile was categorized into one of the following weight status categories: underweight (<5th percentile), normal weight (5th percentile to <85th percentile), overweight (85th percentile to <95th percentile), and obese (≥ 95 th percentile). These categories correspond to the FitnessGram Healthy Fitness Zone categories for weight status: 1) Very Lean; 2) Healthy Fitness Zone; 3) Needs improvement; 4) Needs Improvement – Health Risk.

Results: Weight Status

Overall Sample. Height and weight was measured for approximately 95,000 students and BMI was calculated. In the total sample, which includes boys and girls in 2nd, 5th, 8th, and high school grades, approximately 60% of students had a BMI percentile that was considered normal weight and scored in the Healthy Fitness Zone. Of the remaining students, 16.4% scored in the Needs-Improvement category; 20.2% in the Needs-Improvement – Health Risk category; and 4.1% in the Very Lean category. No marked gender difference in weight status was observed. These findings indicate that approximately two out of every five SC students has an unfavorable weight status for health (Table 1a).

Table 1a. Weight Status among Total Sample and By Sex, South Carolina FitnessGram School Year 2016-2017

Weight Status Variables	Total		Males		Females	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Height, ft (mean, SD)	95,290	4.9 (0.6)	48,986	4.9 (0.6)	46,304	4.8 (0.5)
Height, cm (mean, SD)	95,290	147.9 (16.9)	48,986	149.6 (18.2)	46,304	146.1 (15.2)
Weight, lbs (mean, SD)	95,290	103.3 (43.6)	48,986	104.9 (45.5)	46,304	101.6 (41.5)
Weight, kg (mean, SD)	95,290	46.9 (19.8)	48,986	47.6 (20.7)	46,304	46.1 (18.8)
Body Mass Index (FitnessGram)						
BMI (mean, SD)	95,290	20.6 (5.4)	48,986	20.4 (5.3)	46,304	20.8 (5.6)
% Healthy Fitness Zone	56,517	59.3 %	29,160	59.5%	27,357	59.1%
% Needs Improvement	15,604	16.4%	7,597	15.5%	8,007	17.3%
% Needs Improvement – Health Risk	19,251	20.2%	9,952	20.3%	9,299	20.1%
% Very Lean	3,913	4.1 %	2,275	4.6%	1,638	3.5%
Body Mass Index (CDC program)						
BMI (mean, SD)	95,290	20.6 (5.4)	48,986	20.4 (5.3)	46,304	20.8 (5.6)
Normal	60,488	63.5%	31,457	60.2%	29,031	62.7%
Overweight	15,587	16.4%	7,607	15.5%	7,980	17.2%
Obese	19,215	20.2%	9,922	20.3%	9,293	20.1%

Weight Status in Girls. Body mass index (BMI) was observed to increase with increasing age and grade level in girls. BMI, as calculated by the FitnessGram program, increased from 17.8 in 2nd graders to 24.1 in high school girls. The percent of girls scoring in the Healthy Fitness

Zone was 62.9% in 2nd grade. This percent then decreased in grade 5 to 55.9% before increasing slightly to 57.8% in grade 8 and to 60.0% in high school girls (Table 1b).

Table 1b. Weight Status among Females By Grade Level, South Carolina FitnessGram School Year 2016-2017

Variable	Grade							
	2 nd Grade		5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD
Height, ft (mean, SD)	14,651	4.2 (0.2)	15,882	4.8 (0.3)	8,875	5.3 (0.2)	6,896	5.3 (0.2)
Height, cm (mean, SD)	14,651	128.7 (6.9)	15,882	147.1 (8.6)	8,875	160.6 (6.9)	6,896	162.1 (6.7)
Weight, lbs (mean, SD)	14,651	65.5 (17.6)	15,882	100.4(31.2)	8,875	133.7(36.3)	6,896	139.7(37.4)
Weight, kg (mean, SD)	14,651	29.7 (8.0)	15,882	45.5 (14.2)	8,875	60.7 (16.5)	6,896	63.4 (17.0)
Body Mass Index (FitnessGram)								
BMI (mean, SD)	14,651	17.8 (3.7)	15,882	20.8 (5.2)	8,875	23.4 (5.8)	6,896	24.1 (6.0)
% Healthy Fitness Zone	9,221	62.9%	8,868	55.9%	5,131	57.8%	4,137	60.0%
% Needs Improvement	2,223	15.2%	2,853	18.0%	1,702	19.2%	1,229	17.8%
% Needs Improvement – Health Risk	2,541	17.3%	3,555	22.4%	1,831	20.6%	1,372	19.9%
% Very Lean	666	4.6%	603	3.8%	211	2.4%	158	2.3%
Body Mass Index (CDC program)								
BMI (mean, SD)	14,651	17.8 (3.7)	15,882	20.8 (5.2)	8,875	23.4 (5.8)	6,896	24.1 (6.0)
Normal	9,887	67.5%	9,492	59.8%	5,343	60.2%	4,309	62.5%
Overweight	2,249	15.4%	2,803	17.7%	1,704	19.2%	1,224	17.8%
Obese	2,515	17.2%	3,587	22.6%	1,828	20.6%	1,363	19.8%

As shown in Figures 1a and 1b, BMI and weight status varied across grades and race/ethnicity groups. Concerning race/ethnicity, the percentage of girls in the Healthy Fitness Zone was lower among Black and Hispanic girls compared to White girls and girls of other race/ethnicity groups (including multiracial). Additionally, the percentage of girls in the Healthy Fitness Zone for weight status was lower among students in poverty.

Figure 1a. Weight Status, Body Mass Index (mean), Girls

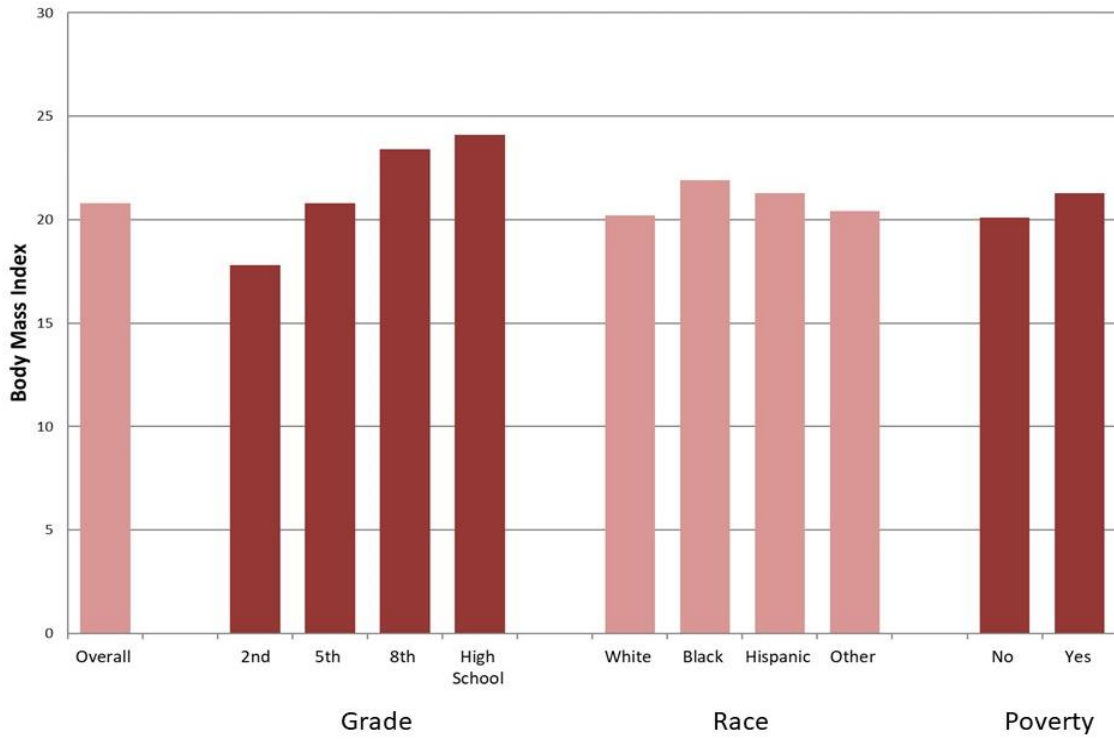
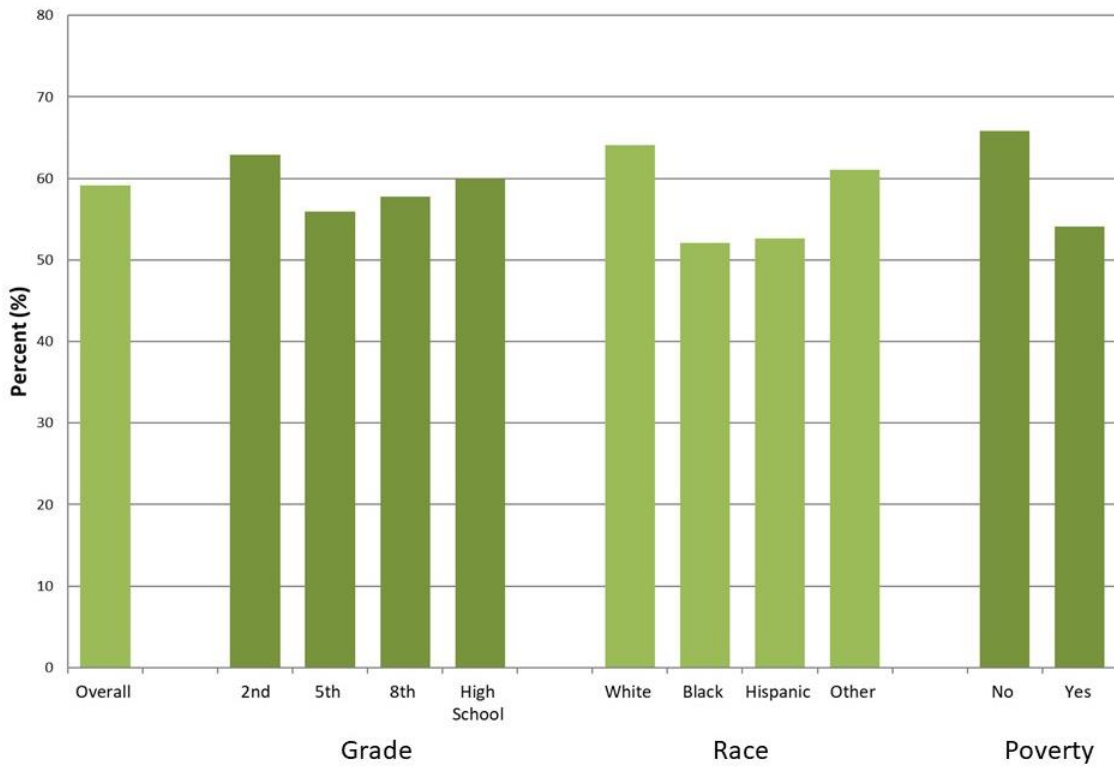


Figure 1b. Weight Status, Percent Attaining Healthy Fitness Zone, Girls



Weight Status in Boys. Similar to girls, body mass index (BMI) increased with increasing age and grade level among boys. BMI, as calculated by the FitnessGram program, increased from 17.6 in 2nd graders to 23.3 in high school boys. The percent of boys scoring in the Healthy Fitness Zone was 63.1% in 2nd grade. The percentage of boys in the Healthy Fitness Zone decreased in 5th grade to 55.5% before increasing slightly to 59.6% in grade 8 and 60.8% in high school boys (Table 1c).

Table 1c. Weight Status among Males_By Grade, South Carolina FitnessGram School Year 2016-2017

Variable	Grade							
	2 nd Grade		5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD
Height, ft (mean, SD)	14,940	4.3 (0.2)	15,937	4.8 (0.3)	9,838	5.5 (0.3)	8,271	5.7 (0.3)
Height, cm (mean, SD)	14,940	129.6 (6.8)	15,937	146.0 (8.1)	9,838	166.5 (8.9)	8,271	172.3 (8.2)
Weight, lbs (mean, SD)	14,940	65.8 (17.0)	15,937	96.4 (29.5)	9,838	137.4 (39.6)	8,271	153.2 (41.7)
Weight, kg (mean, SD)	14,940	29.9 (7.7)	15,937	43.8 (13.4)	9,838	62.3 (18.0)	8,271	69.5 (18.9)
Body Mass Index (FitnessGram)								
BMI (mean, SD)	14,940	17.6 (3.5)	15,937	20.3 (4.9)	9,838	22.3 (5.5)	8,271	23.3 (5.7)
% Healthy Fitness Zone	9,433	63.1%	8,844	55.5%	5,857	59.6%	5,026	60.8%
% Needs Improvement	2,198	14.7%	2,635	16.5%	1,519	15.4%	1,245	15.1%
% Needs Improvement – Health Risk	2,586	17.3%	3,754	23.6%	1,973	20.1%	1,639	19.8%
% Very Lean	723	4.8%	704	4.4%	487	5.0%	361	4.4%
Body Mass Index (CDC program)								
BMI (mean, SD)	14,940	17.6 (3.5)	15,937	20.3 (4.9)	9,838	22.3 (5.5)	8,271	23.3 (5.7)
Normal	10,144	67.9%	9,561	60.0%	6,329	64.3%	5,423	65.6%
Overweight	2,190	14.7%	2,648	16.6%	1,547	15.7%	1,222	14.8%
Obese	2,606	17.4%	3,728	23.4%	1,962	19.9%	1,626	19.7%

BMI and weight status varied across grade, race/ethnicity, and poverty status (Figures 1c and 1d). Compared to girls, differences in BMI across race/ethnicity groups were less pronounced. The percentage of boys in the Healthy Fitness Zone was lower among Hispanic boys compared to the remaining race/ethnicity groups. Again, the percentage of boys in the Healthy Fitness Zone for weight status was lower among students in poverty.

Figure 1c. Weight Status, Body Mass Index (mean), Boys

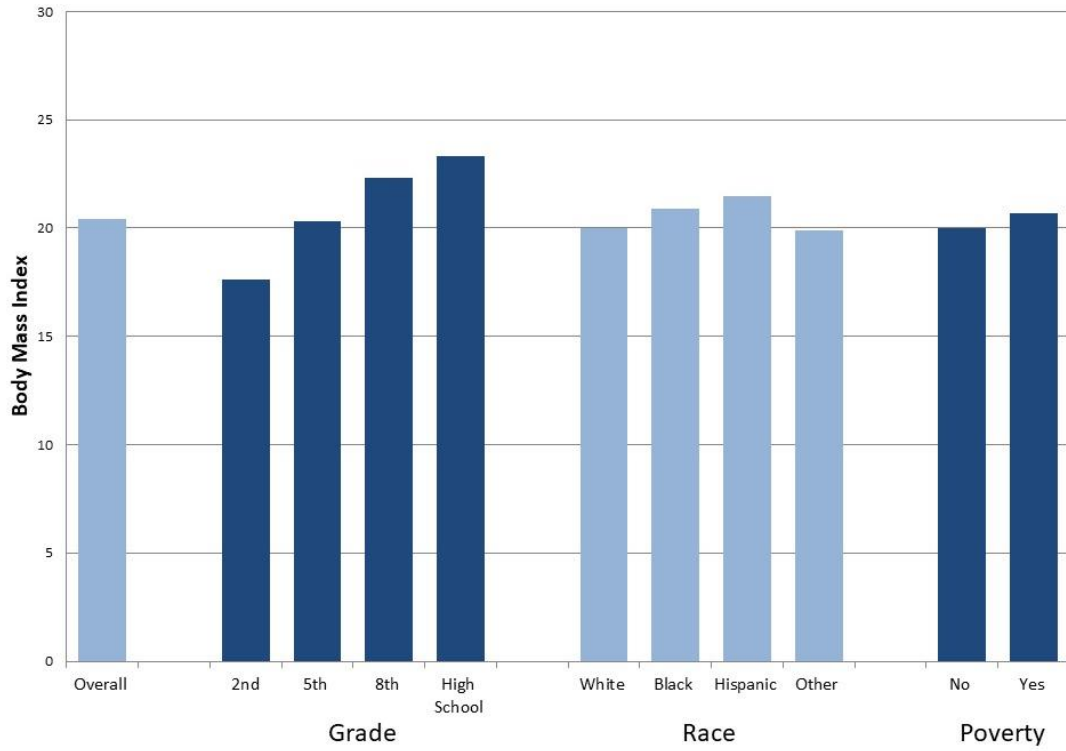
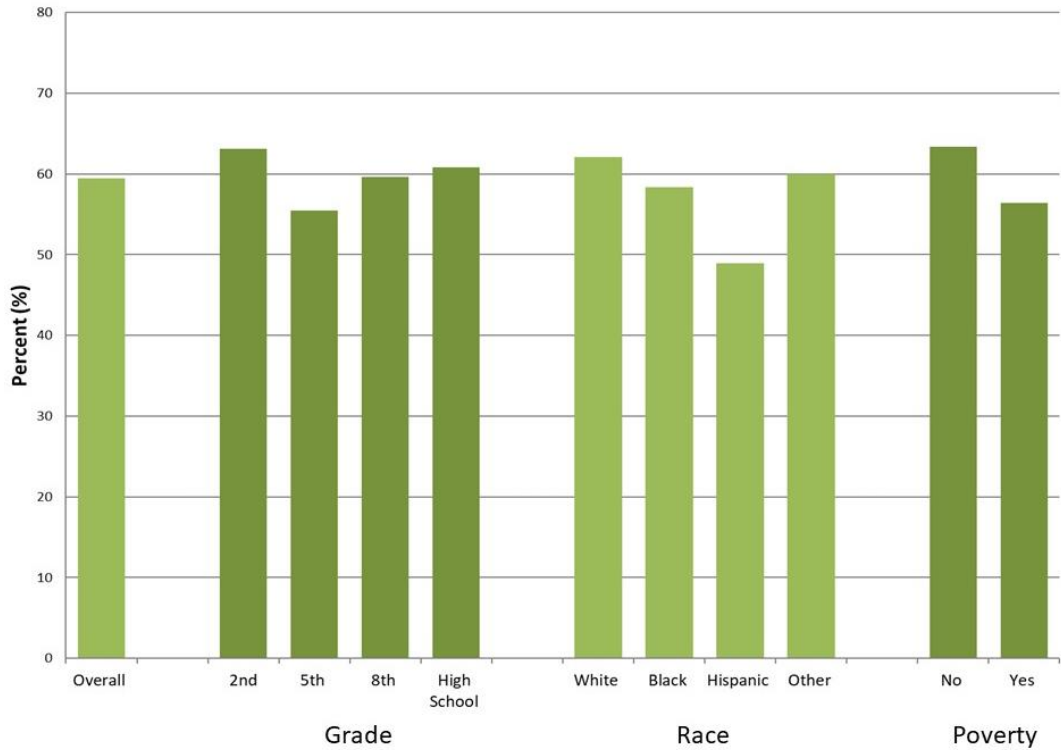


Figure 1d. Weight Status, Percent Attaining Healthy Fitness Zone, Boys



Key Findings and Conclusions

A key finding was that rates of overweight and obesity among South Carolina students are high with nearly 36% failing to attain the Healthy Fitness Zone for weight status.

The following patterns were observed:

- The percentage of students attaining the Healthy Fitness Zone for weight status was very similar in girls and boys.
- The percentage of students attaining the Healthy Fitness Zone tended to increase between 5th grade and high school in both genders.
- The percentage of students attaining the Healthy Fitness Zone was lower in Black and Hispanic students than in White and other race/ethnicity students.
- The percentage of students that attained the Healthy Fitness Zone for weight status was lower among students in poverty compared to students not in poverty.

2. Cardiorespiratory Fitness

Definition. Cardiorespiratory fitness refers to a person's ability to perform large-muscle, whole-body physical activity for extended periods of time. Examples of physical activities that require cardiorespiratory fitness are brisk walking, running, stair-climbing, and participation in sports such as basketball and soccer. Cardiorespiratory fitness depends on the functional capacity of the body's cardiovascular, respiratory, and muscular systems. A physiological measure of this capacity is maximal aerobic power, or the maximal rate at which the body is able to take in, transport and consume oxygen (VO₂max).

Relationship to Health. Maintaining good levels of cardiorespiratory fitness is important to health during childhood, adolescence, and adulthood. During all life stages, higher cardiorespiratory fitness is associated with lower risk for future development of conditions such as heart disease, type 2 diabetes, and certain cancers. Also, cardiorespiratory fitness is needed to perform physically demanding occupational tasks. Consequently, good cardiorespiratory fitness during adolescence is an important prerequisite to eligibility for occupations such as law enforcement, farming, and military service.

Measures. In the FitnessGram protocol cardiorespiratory fitness is measured with one of three optional field tests: 1) Progressive Aerobic Cardiovascular Endurance Run (PACER) test; 2) 1-mile run test; or 3) a walk test. The majority of students completing the FitnessGram protocol in South Carolina completed the PACER test. The PACER is a multistage exercise test that involves running back and forth across a 15 or 20-meter space at a progressively increasing pace. The PACER is scored as the number of laps that are completed before fatigue causes the student to fall behind the prescribed pace. Some students completed the 1-mile run test. Performance on the 1-mile run test is scored as the time required to run and/or walk the 1-mile distance.

Variable for analysis. Performance on each of the cardiorespiratory fitness tests can be used to estimate the student's maximal aerobic power (VO₂max). Each student's performance is scored as the corresponding VO₂max value, and that score is placed in one of three categories that are based on age- and sex-specific criteria. The categories are: 1) Healthy Fitness Zone; 2) Needs improvement; 3) Needs Improvement – Health Risk.

Results: Cardiorespiratory Fitness

Overall Sample. Over 71,000 students completed tests of cardiorespiratory fitness, and most of them completed the PACER test. In the total sample, which includes boys and girls in 5th, 8th and high school grades, just over one-half scored in the Healthy Fitness Zone. The remainder was approximately equally divided between those who scored in the Needs Improvement and Needs Improvement – Health Risk categories. Because cardiorespiratory fitness is a powerful predictor of long-term health, it is a great concern that nearly one-half of South Carolina’s students tested did not attain the Healthy Fitness Zone and that approximately one quarter scored in the Needs Improvement – Health Risk category.

A clear gender difference was observed. Estimated VO₂max was higher in boys than girls, and a greater percentage of boys than girls (58.9% vs. 42.7%) scored in the Healthy Fitness Zone for the test of cardiorespiratory fitness. Additionally, among those failing to attain the Healthy Fitness Zone, a larger percentage of girls than boys scored in the Needs Improvement – Health Risk category (26.4% vs. 23.1%) (Table 2a). These findings indicate that low cardiorespiratory fitness is a particular concern in girls. However, substantial percentages of both boys and girls performed at a very low level on this test.

Table 2a. Cardiorespiratory Fitness for Total Sample and By Sex; South Carolina FitnessGram School Year 2016-2017

Cardiorespiratory Fitness Variables	Total		Males		Females	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Estimated VO ₂ max	71,715	42.0 (6.5)	37,336	43.8 (7.1)	34,379	40.0 (5.1)
Field Test						
PACER	67,752	41.8 (6.5)	34,880	53.6 (7.1)	32,872	40.0 (5.1)
1-Mile Run	3,745	44.6 (6.4)	2,361	46.5 (6.3)	1,384	41.2 (4.9)
Walk Test	218	41.8 (7.1)	95	44.4 (7.9)	123	39.8 (5.7)
Fitness Zone Categories	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	36,641	51.1%	21,975	58.9%	14,666	42.7%
Needs Improvement	17,375	24.2%	6,742	18.1%	10,633	30.9%
Needs Improvement – Health Risk	17,699	24.7%	8,619	23.1%	9,080	26.4%

Cardiorespiratory Fitness in Girls. Cardiorespiratory fitness declined with increasing age and grade level in girls. VO₂max decreased from 41.0 in 5th graders to 38.6 in high school

girls. The percentage of girls attaining the Healthy Fitness Zone decreased from 46.4 % in fifth graders to 38.7% in high school girls (Table 2b).

Table 2b. Cardiorespiratory Fitness Among Females by Grade; South Carolina FitnessGram School Year 2016-2017

Cardiorespiratory Fitness Variables	Grade*					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Estimated VO ₂ max	17,224	41.0 (4.5)	8,875	39.4 (5.4)	7,372	38.6 (5.5)
Field Test						
PACER	16,903	41.0 (4.5)	9,606	39.3 (5.4)	6,363	38.2 (5.6)
Mile	321	42.6 (4.8)	151	40.9 (5.2)	912	40.7 (4.8)
Walk	--	--	26	39.7 (4.4)	97	39.8 (6.0)
Fitness Zone Categories	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	7,995	46.4%	3,820	39.1%	2,851	38.7%
Needs Improvement	6,277	36.4%	2,633	26.9%	1,723	23.4%
Needs Improvement: Health Risk	2,952	17.1%	3,330	34.0%	2,789	38.0%

**cardiorespiratory fitness was not assessed for 2nd grade students (n=30,167)*

As shown in Figures 2a and 2b, cardiorespiratory fitness was associated with weight status such that poorer performance was observed in those who were overweight and obese than in those who were normal weight. The percentage of girls in the Healthy Fitness Zone was over 55% in normal weight girls but decreased to 33% in those who were overweight and to 14% in those who were obese. Also, performance on the cardiorespiratory fitness test was associated with race/ethnicity and poverty status. The percentage of girls in the Healthy Fitness Zone for cardiorespiratory fitness was lower among Black students and students living in poverty.

Figure 2a. Cardiorespiratory Fitness, Estimated VO2max (mean), Girls

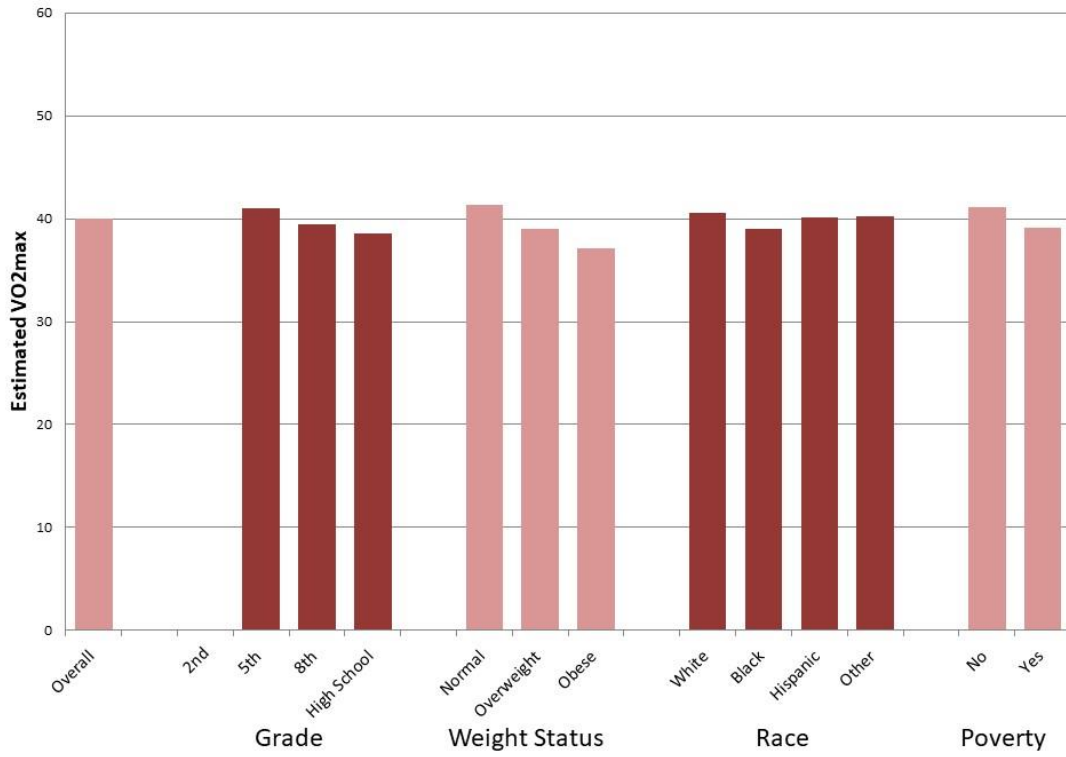
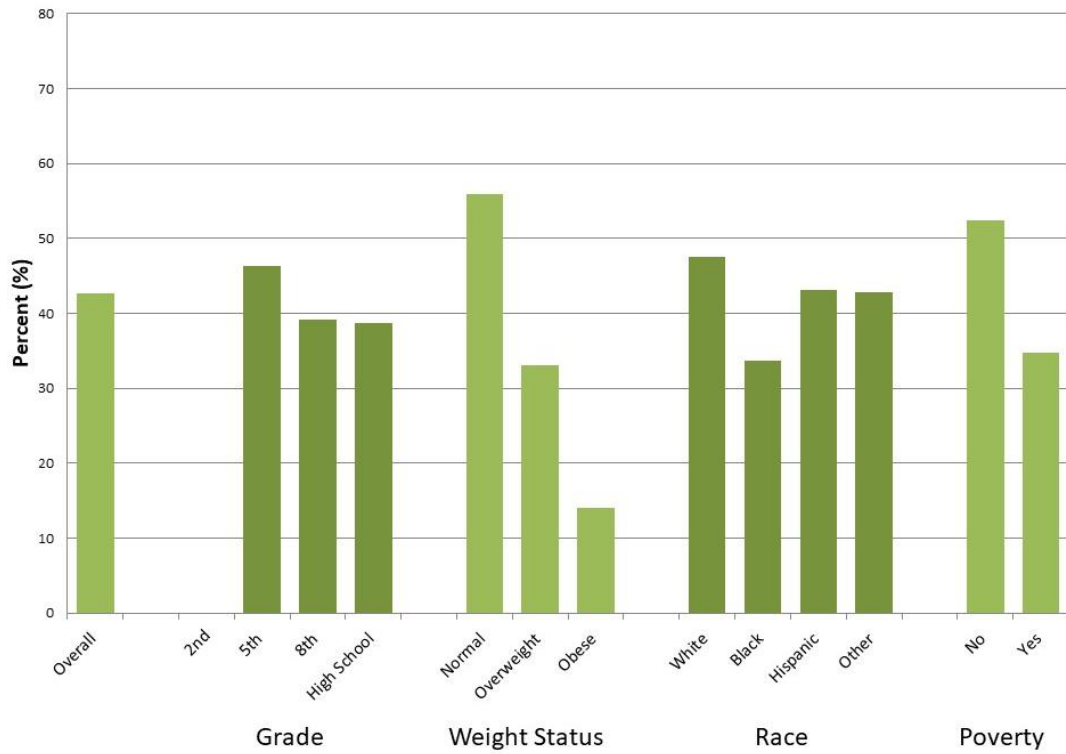


Figure 2b. Cardiorespiratory Fitness, Percent Attaining Healthy Fitness Zone, Girls



Cardiorespiratory Fitness in Boys. In boys, cardiorespiratory fitness as reflected by VO₂max increased modestly with increasing age and grade levels. However, the percentage of boys attaining the Healthy Fitness Zone decreased from 61.8% in 5th graders to 58.1% in 8th graders and to 53.9% in high school students (Table 2c).

Table 2c. Cardiorespiratory Fitness Among Males By Grade, South Carolina FitnessGram; School Year 2016-2017

Cardiorespiratory Fitness Variables	Grade*					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Estimated VO ₂ max	17,507	43.2 (6.1)	10,899	44.2 (7.6)	8,930	44.4 (8.1)
Field Test						
PACER	17,152	43.1 (6.1)	10,555	44.2 (7.6)	7,173	43.9 (8.3)
Mile	355	46.9 (5.6)	317	46.2 (5.7)	1,689	46.5 (6.6)
Walk	--	--	27	40.5 (3.4)	68	45.9 (8.6)
Fitness Zone Categories	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	10,825	61.8%	6,333	58.1%	4,817	53.9%
Needs Improvement	4,230	24.2%	1,363	12.5%	1,149	12.9%
Needs Improvement: Health Risk	2,452	14.0%	3,203	29.4%	2,964	33.2%

**cardiorespiratory fitness was not assessed for 2nd grade students (n=30,167)*

The same association between cardiorespiratory fitness and weight status was observed in boys as in girls. Over 70% of normal weight boys scored in the Healthy Fitness Zone, but much smaller percentages of overweight and obese boys attained the Healthy Fitness Zone. The association between race/ethnicity and cardiorespiratory fitness was less pronounced in boys than girls (Figures 2c & 2d). A similar pattern between cardiorespiratory fitness and poverty status was also observed. Specifically, a smaller percentage of boys in poverty attained the Healthy Fitness Zone for cardiorespiratory fitness compared to boys not living in poverty.

Figure 2c. Cardiorespiratory Fitness, Estimated VO2max (mean), Boys

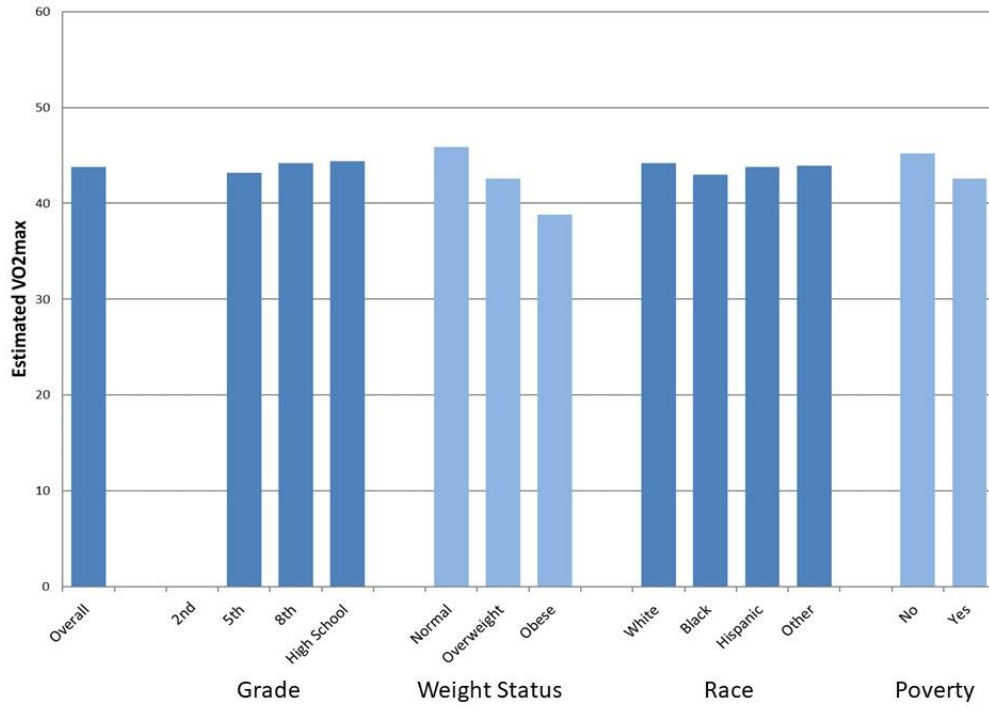
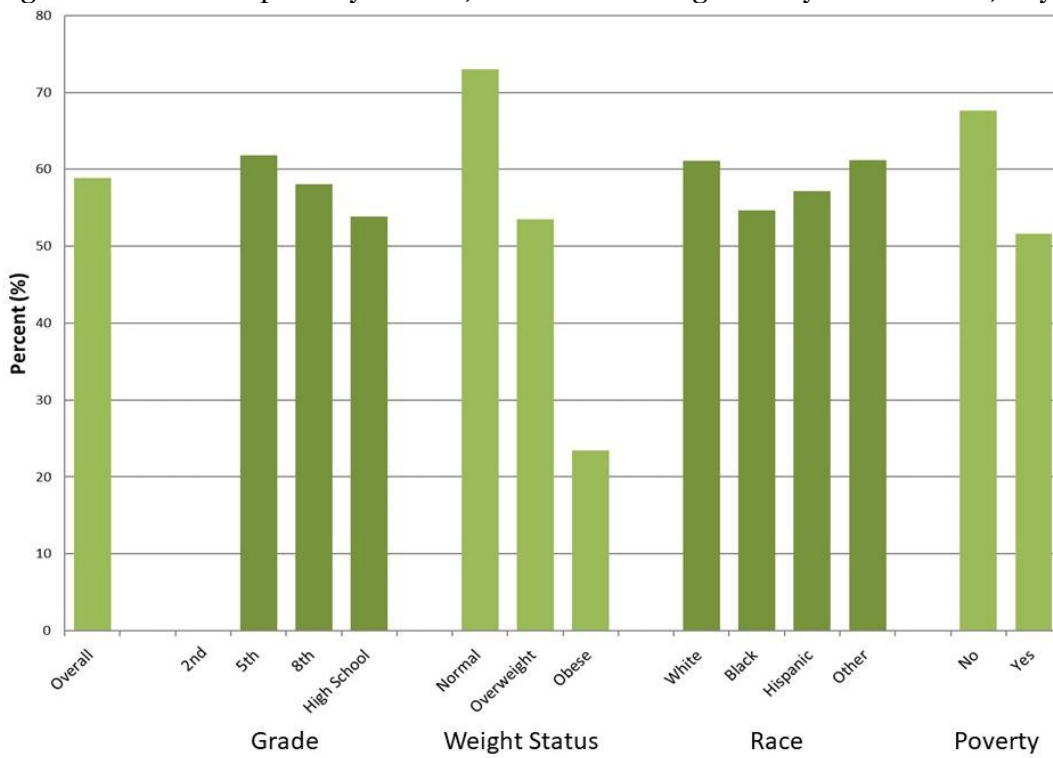


Figure 2d. Cardiorespiratory Fitness, Percent Attaining Healthy Fitness Zone, Boys



Key Findings and Conclusions

A key finding was that only one-half of South Carolina students attained the Healthy Fitness Zone for cardiorespiratory fitness.

The following patterns were observed:

- A smaller percentage of girls than boys attained the Healthy Fitness Zone.
- The percentage of students attaining the Healthy Fitness Zone decreased with increasing age and grade level.
- The percentage of students attaining the Healthy Fitness Zone was lower in Black students than in white students, and these trends were more pronounced in girls than boys.
- Performance on the cardiorespiratory fitness test was associated with weight status such that a higher percentage of normal weight students attained the Healthy Fitness Zone than did those in the overweight or obese categories.
- Among girls and boys, the percentage of students attaining the Healthy Fitness Zone for cardiorespiratory fitness was lower among students in poverty.

3. Upper Body Strength and Endurance – Push Ups

Definition. Muscular strength is the ability to generate force through contraction of the skeletal muscles and to apply that force to the body or to external objects. Muscular endurance refers to the ability to perform repeated muscle contractions or to sustain a muscle contraction against external resistance. Upper body muscular strength and endurance is a person's ability to generate force and to perform repeated muscular contractions against resistance using the musculature of the upper arm girdle.

Relationship to Health. Upper body muscular strength and endurance is related to health through its impact on daily function. Persons with adequate upper body muscular strength and endurance can perform household and occupational tasks safely, appropriately and without undue stress. Further, they are able to support their body weight with the upper body musculature as may be necessary in performance of leisure activities and in cases of emergency.

Measures. The 90° push-up is the recommended test item to assess upper body strength and endurance in the FitnessGram protocol. Alternate assessment tests include the modified pull-up, pull-up, and the flexed arm hang. The majority of the students completing the FitnessGram protocol in South Carolina completed the 90° push-up test. The objective of the test is to complete as many push-ups as possible at a rhythmic pace (cadence = 20 push-ups per minute or 1 push-up every 3 seconds). The test ceases when the student can no longer perform a push-up or when a second form correction is made (e.g., not maintaining pace; not achieving 90° angle with elbows).

Variable for analysis. Performance on the push-up test for upper body strength and endurance is scored by counting the number of 90° push-ups performed. Each student's score is then placed in one of two Healthy Fitness Zone categories using age- and sex-specific criteria. The categories are: 1) Healthy Fitness Zone; 2) Needs Improvement.

Results: Upper Body Strength and Endurance

Overall Sample. Approximately 70,000 students completed the push-up test of upper body strength and endurance. For the total sample of students, which included boys and girls in grades 5, 8, and high school, the mean number of push-ups completed was 11.3. Nearly 60% of

the total sample scored in the Healthy Fitness Zone while the remaining 40% scored in the Needs Improvement category. In general, boys performed slightly better than girls on the upper body strength and endurance test component. On average, boys performed about five more push-ups than girls. Additionally, slightly more boys scored in the Healthy Fitness Zone compared to girls (60.7% vs. 56.7%) (Table 3a). These findings suggest that only three out of every five South Carolina students have adequate levels of upper body strength and endurance for health.

Table 3a. Upper Body Strength/Endurance - Push Ups; Total Sample and By Sex, South Carolina FitnessGram School Year 2016-2017

Upper Body Strength and Endurance Variables	Total		Males		Females	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Push-Ups	69,692	11.3 (8.6)	35,678	13.6 (9.1)	33,536	8.8 (7.3)
Fitness Zone Categories	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	40,991	58.8 %	21,912	60.7%	19,079	56.7%
Needs Improvement	28,701	41.2%	14,145	39.3%	14,556	43.3%

Upper Body Strength and Endurance in Girls. In girls, upper body strength and endurance increased from 5th grade to 8th grade and then decreased slightly in high school (Table 3b). Specifically, the number of push-ups performed increased from 7.7 in 5th grade to 9.9 in 8th grade, and then decreased slightly to 9.6 push-ups in high school. The percentage of girls attaining the Healthy Fitness Zone increased from 47.8% in fifth graders to 65.6% in high school girls.

Table 3b. Upper Body Strength/Endurance - Push Ups; Females By Grade, South Carolina FitnessGram School Year 2016-2017

Upper Body Strength and Endurance Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Push-Ups	16,159	7.7 (7.2)	9,765	9.9 (7.3)	7,350	9.6 (7.1)
Fitness Zone Categories	n	Percent	n	Percent	n	Percent
% Healthy Fitness Zone	7,737	47.8%	6,410	65.6%	4,760	65.6%
% Needs Improvement	8,422	52.1%	3,355	34.4%	2,590	34.4%

**upper body strength and endurance was not assessed for 2nd grade students (n=30,167)*

As shown in Figures 3a and 3b, upper body strength and endurance was associated with weight status such that poorer performance was observed in those who were overweight and obese compared to those who were normal weight. The percentage of girls in the Healthy Fitness Zone was over 65% in normal weight girls but decreased to 51% in those who were overweight and to 35% in those who were obese. Also, performance on the upper body strength and endurance test varied across race/ethnicity groups and poverty status. Push-up performance was lower in Black and Hispanic girls than in White girls and girls from other races/ethnicities backgrounds; and lower among girls living in poverty.

Figure 3a. Upper Body Strength/Endurance, Push-Ups (mean), Girls

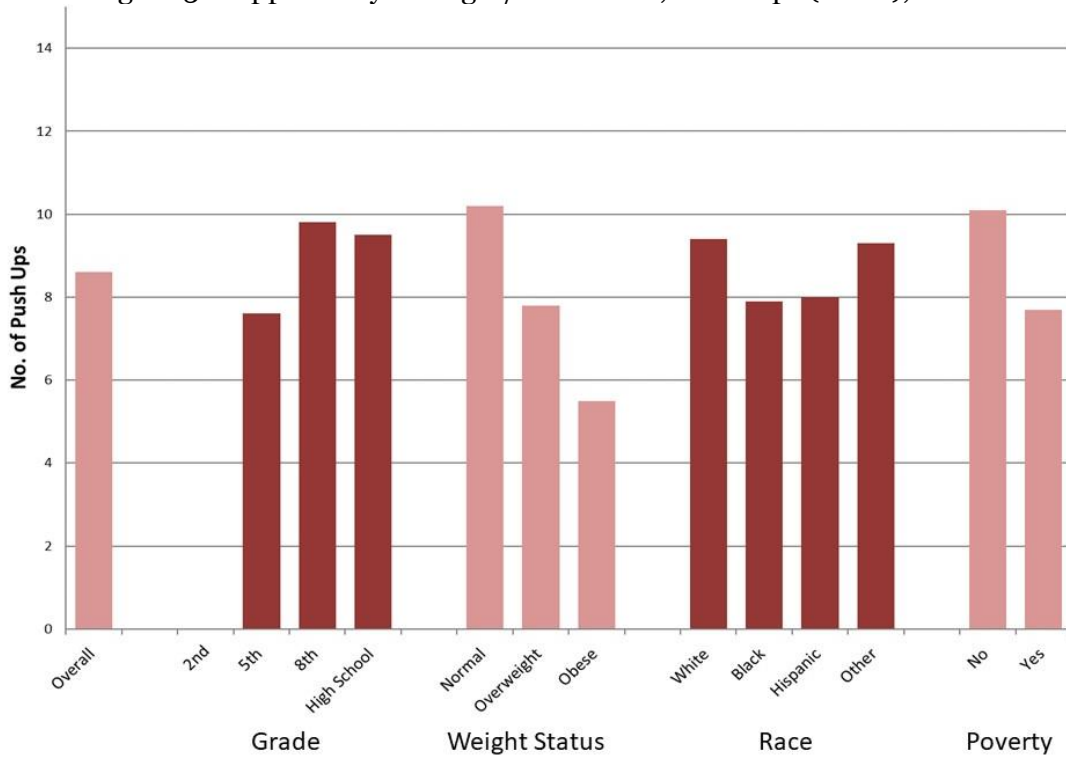
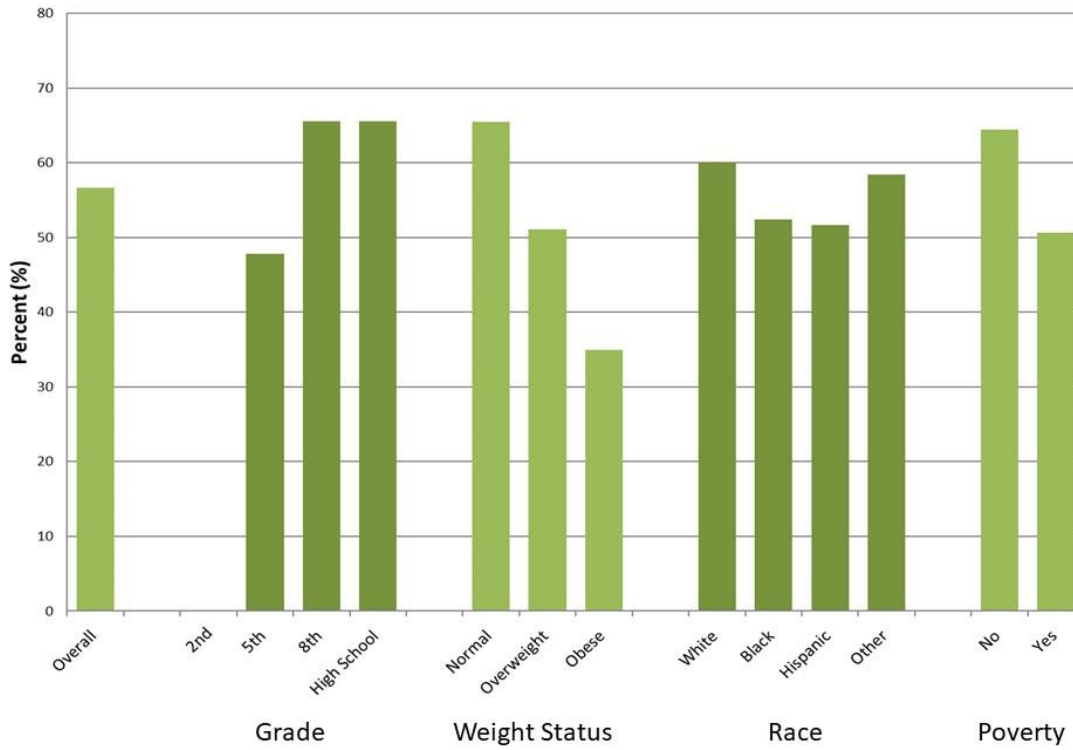


Figure 3b. Upper Body Strength/Endurance – Push-Ups, Percent Attaining Healthy Fitness Zone, Girls



Upper Body Strength and Endurance in Boys. Among boys, upper body strength and endurance increased with increasing age and grade levels. However, the percentage of boys attaining the Healthy Fitness Zone decreased modestly from 63.1% in 5th graders to 56.5% in high school students (Table 3c).

Table 3c. Upper Body Strength/Endurance – Push-Ups; Males By Grade, South Carolina FitnessGram; School Year 2016-2017

Upper Body Strength and Endurance Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Push-Ups (mean, SD)	16,345	11.0 (8.6)	10,749	15.4 (9.0)	8,579	16.8 (8.7)
Fitness Zone Categories	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	10,312	63.1%	6,521	60.7%	4,849	56.5%
Needs Improvement	6,033	36.9%	4,228	39.3%	3,730	43.5%

**upper body strength and endurance was not assessed for 2nd grade students (n=30,167)*

The same association between upper body strength and endurance and weight status was observed in boys as in girls. Over 70% of normal weight boys scored in the Healthy Fitness Zone, but much smaller percentages of overweight and obese boys attained the Healthy Fitness Zone. The association between race/ethnicity and upper body strength and endurance was less pronounced in boys than girls, with Black students performing slightly better than other race/ethnicity groups. Similar to girls, the percentage of boys attaining the Healthy Fitness Zone for upper body strength was lower among students in poverty (Figures 3c and 3d).

Figure 3c. Upper Body Strength/Endurance, Push-Ups (mean), Boys

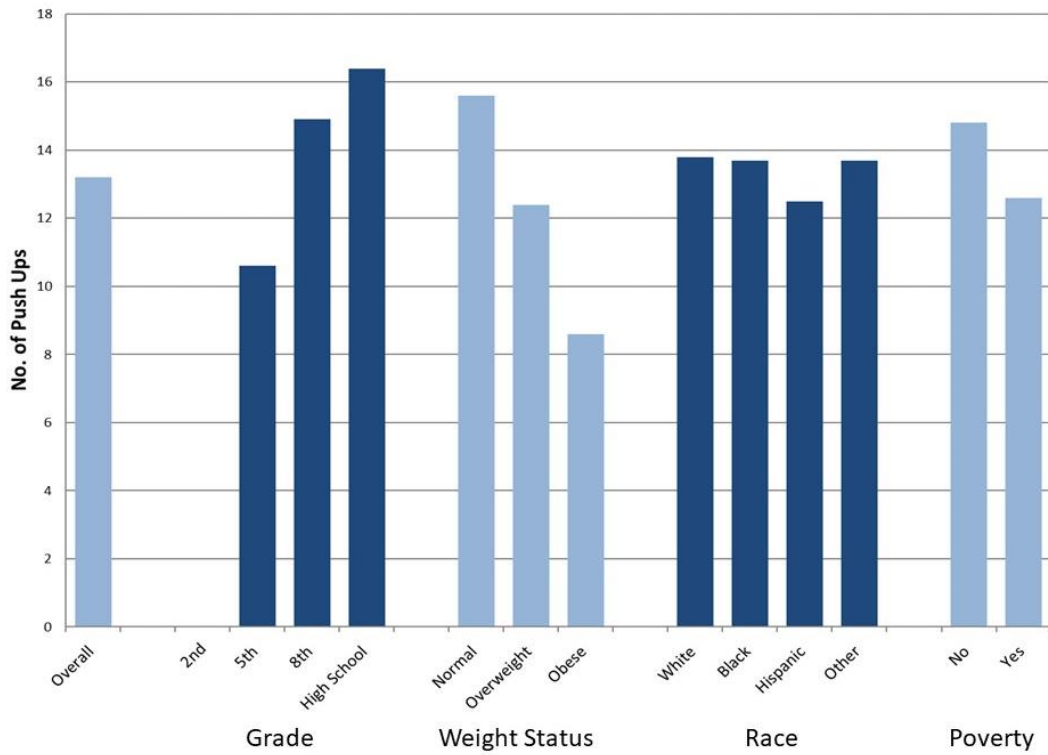
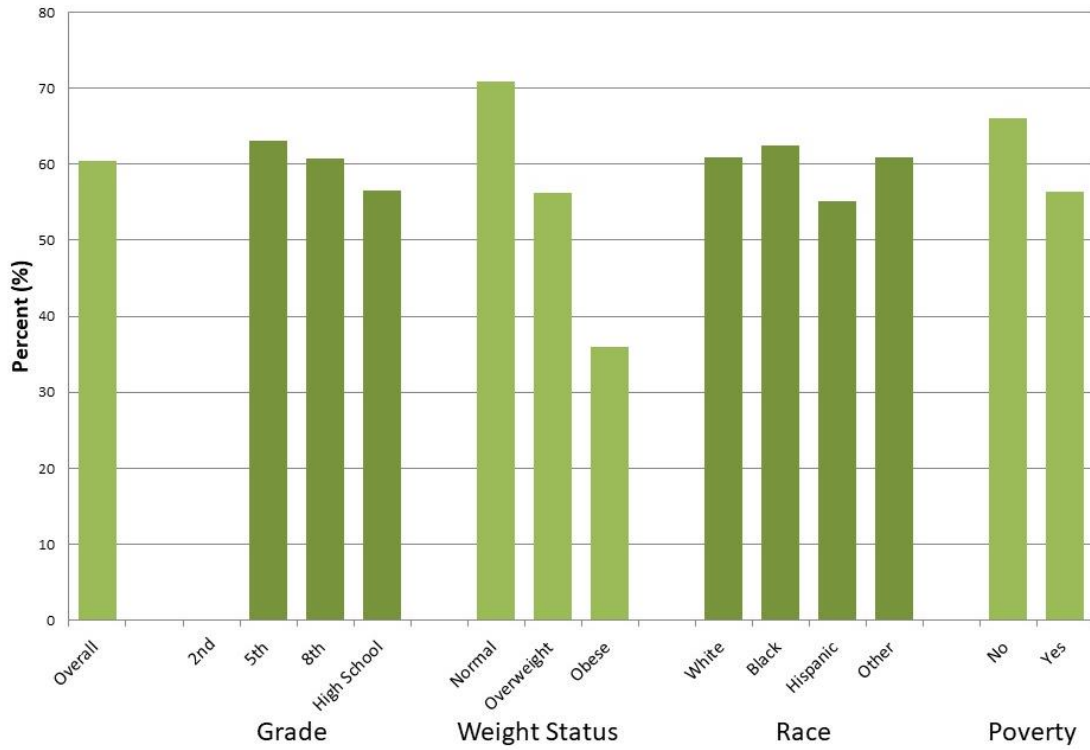


Figure 3d. Upper Body Strength/Endurance – Push-Ups, Percent Attaining Healthy Fitness Zone, Boys



Key Findings and Conclusions

A key finding of the assessment of upper body strength and endurance was that roughly 60% of South Carolina students attained the Healthy Fitness Zone for push-ups.

The following patterns were observed:

- Overall, the percentage of students scoring in the Healthy Fitness Zone category for push-ups was similar for boys and girls.
- Across grade levels, the percentage of girls attaining the Healthy Fitness Zone increased with increasing grade level while the percentage of boys decreased with increasing grade level.
 - In 5th grade, a smaller percentage of girls than boys attained the Healthy Fitness Zone for push-ups (47.8% vs. 63.1%).
 - In high school, a larger percentage of girls than boys attained the Healthy Fitness Zone for push-ups (65.6% vs. 56.5%).
- Among girls, the percentage of students attaining the Healthy Fitness Zone was lower in Black and Hispanic students than in White students. In boys, the percentage attaining the Healthy Fitness Zone was lower in Hispanic students compared to White and Black students.
- Performance on the upper body strength and endurance test was associated with weight status such that a higher percentage of normal weight students attained the Healthy Fitness Zone than did those in the overweight or obese categories.
- Concerning poverty status, the percentage of students attaining Healthy Fitness Zone for upper body strength was lower among students in poverty compared to those not living in poverty.

4. Abdominal Muscular Strength and Endurance – Curl-Ups

Definition. Muscular strength is the ability to generate force through contraction of the skeletal muscles and to apply that force to the body or to external objects. Muscular endurance refers to the ability to perform repeated muscle contractions or to sustain a muscle contraction against external resistance. Abdominal muscular strength and endurance is a person's ability to generate force and to perform repeated muscular contractions against resistance using the musculature of the abdomen.

Relationship to Health. Abdominal muscular strength and endurance is important in promoting good posture and alignment of the pelvis and spine. An adequate level of abdominal strength and endurance is important and impacts health through maintenance of lower back health.

Measures. The curl-up is the recommended test item to assess abdominal muscular strength and endurance in the FitnessGram protocol. Students lie on their backs with knees bent, feet flat on the floor, and arms parallel to the body with palms facing down. To perform a curl-up, students lift their head and shoulders off the mat and stretch their fingers across a measuring strip and then lower back down to the floor. The objective of the curl-up test is to complete as many curl-ups as possible at a specified pace of one curl-up every three seconds (max 75 curl-ups). The test ceases when 1) the student can no longer perform a curl-up, 2) the second form correction is made, or 3) the student completes 75 curl-ups.

Variable for analysis. Performance on the curl-up test for abdominal muscular strength and endurance is scored by counting the number of curl-ups performed with correct form. Each student's score is then categorized into one of two Healthy Fitness Zone categories using age- and sex-specific criteria. The categories are: 1) Healthy Fitness Zone; 2) Needs Improvement.

Results: Abdominal Muscular Strength and Endurance

Overall Sample. Approximately 73,000 students completed the curl-up test for abdominal muscular strength and endurance. The average number of curl-ups completed was 27.5 for the total sample, which included boys and girls from grades 5, 8 and high school. A majority of the students (~70%) in the total sample scored in the Healthy Fitness Zone category for abdominal

muscular strength and endurance; the remaining 30% scored in the Needs Improvement category. On average, boys performed slightly better on the abdominal muscular strength and endurance test than girls (Table 4a).

Table 4a. Abdominal muscular Strength and Endurance –Curl-Ups; South Carolina FitnessGram; Total Sample and By Sex, School Year 2016-2017

Abdominal Strength and Endurance Variables	Total		Males		Females	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Curl-Ups (mean, SD)	72,755	27.5 (20.1)	37,348	30.1 (20.9)	35,407	24.7 (18.9)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	50,329	69.2%	26,387	70.7%	23,942	67.6%
Needs Improvement	22,426	30.8%	10,961	29.4%	11,465	32.4%

Abdominal Muscular Strength and Endurance in Girls. Among girls, the number of curl-ups completed during the muscular strength and endurance test increased from 5th grade to 8th grade and then decreased slightly in high school (Table 4b). However, the percentage of girls attaining the Healthy Fitness Zone increased from 62.1% in fifth graders to 73.7% in high school girls.

Table 4b. Abdominal Muscular Strength and Endurance – Curl-Ups; South Carolina FitnessGram; Females By Grade, School Year 2016-2017

Abdominal Muscular Strength and Endurance Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Curl-Ups (mean, SD)	16,835	20.2 (16.8)	10,032	30.4 (20.7)	7,941	28.0 (18.1)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	10,447	62.1%	7,270	72.5%	5,850	73.7%
Needs Improvement	6,388	37.9%	2,762	27.5%	2,091	26.3%

**abdominal strength was not assessed for 2nd grade students (n=30,167)*

Across demographic subgroups, differences in performance on the curl-up test for abdominal muscular strength and endurance emerged (Figures 4a and 4b). Similar to other FitnessGram test components, poorer performance on the abdominal muscular strength and endurance test was observed in overweight and obese students compared to normal weight students. Comparing race/ethnicity groups, performance on the abdominal muscular strength and endurance test was lower in Black and Hispanic girls compared to White girls and girls from other races/ethnicities. Poorer performance on the abdominal muscular strength and endurance test was also observed among students in poverty.

Figure 4a. Abdominal Muscular Strength/Endurance, Curl-Ups (mean), Girls

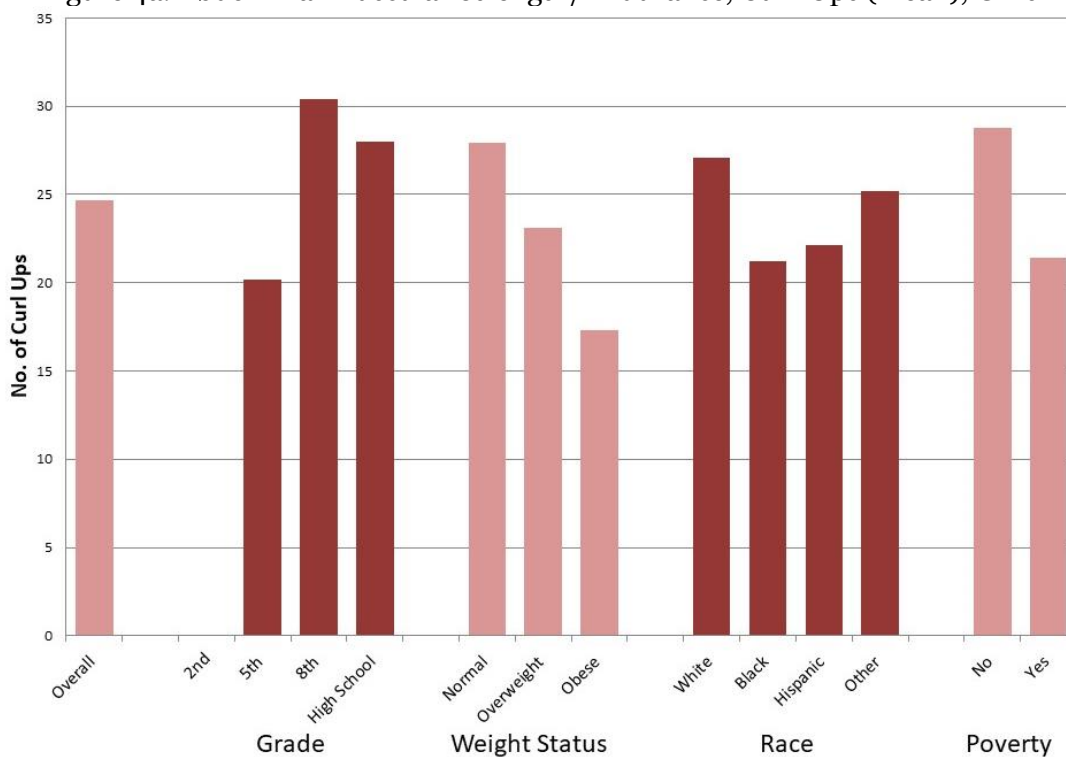
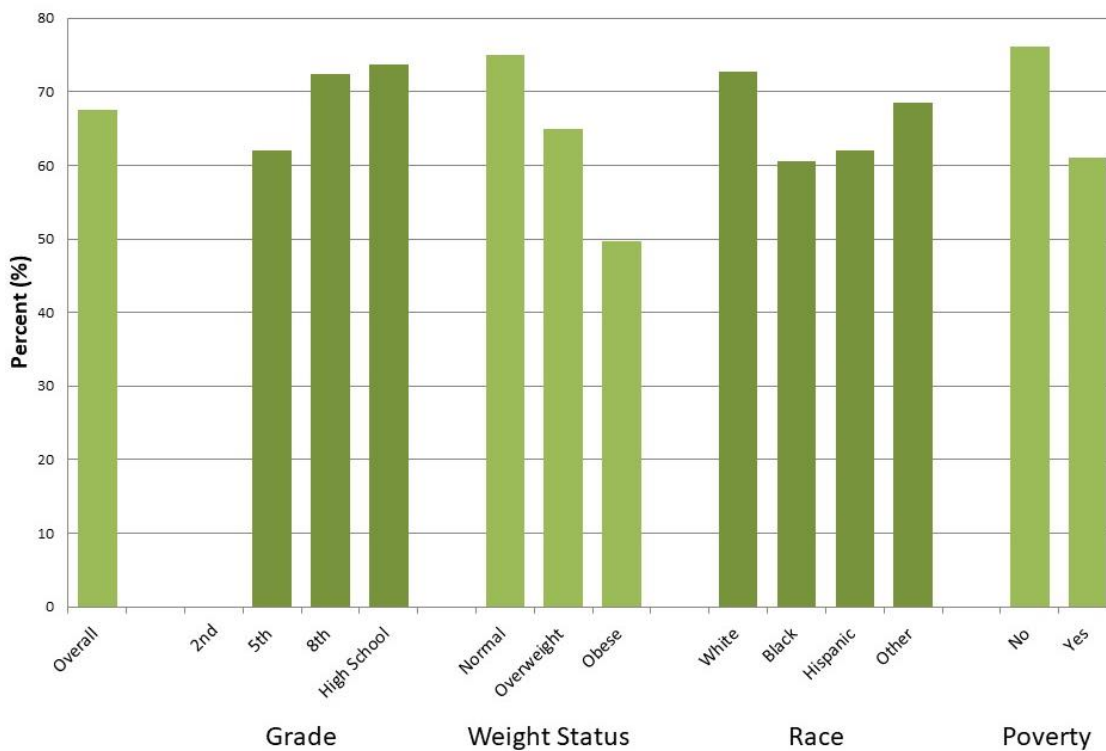


Figure 4b. Abdominal Muscular Strength/Endurance – Curl-Ups, Percent Attaining Healthy Fitness Zone, Girls



Abdominal Muscular Strength and Endurance in Boys. Similar to girls, the number of curl-ups completed during the abdominal muscular strength and endurance test increased from 5th to 8th grade, and then decreased slightly in high school. However, the percentage of boys attaining the Healthy Fitness Zone for abdominal muscular strength and endurance increased with increasing age and grade level (Table 4c).

Table 4c. Abdominal Muscular Strength and Endurance - South Carolina FitnessGram; Males By Grade, School Year 2016-2017

Abdominal Strength and Endurance Variables	Grade*					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Curl-Ups (mean, SD)	16,919	22.5 (18.1)	11,009	38.2 (22.0)	8,830	35.8 (18.9)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	11,147	65.9%	8,178	74.3%	6,659	75.4%
Needs Improvement	5,772	34.1%	2,831	25.7%	2,171	24.6%

*abdominal strength was not assessed for 2nd grade students (n=30,167)

The same association between abdominal muscular strength and endurance and weight status was observed in boys as in girls. Approximately 77% of normal weight boys scored in the Healthy Fitness Zone while only 71% of overweight and 53% of obese boys attained the Healthy Fitness Zone. While a similar pattern between race/ethnicity and abdominal muscular strength and endurance was observed, it was less pronounced in boys than girls. Again, poorer performance on the abdominal muscular strength and endurance test was also observed among students in poverty (Figures 4c and 4d).

Figure 4c. Abdominal Muscular Strength/Endurance, Curl-Ups (mean), Boys

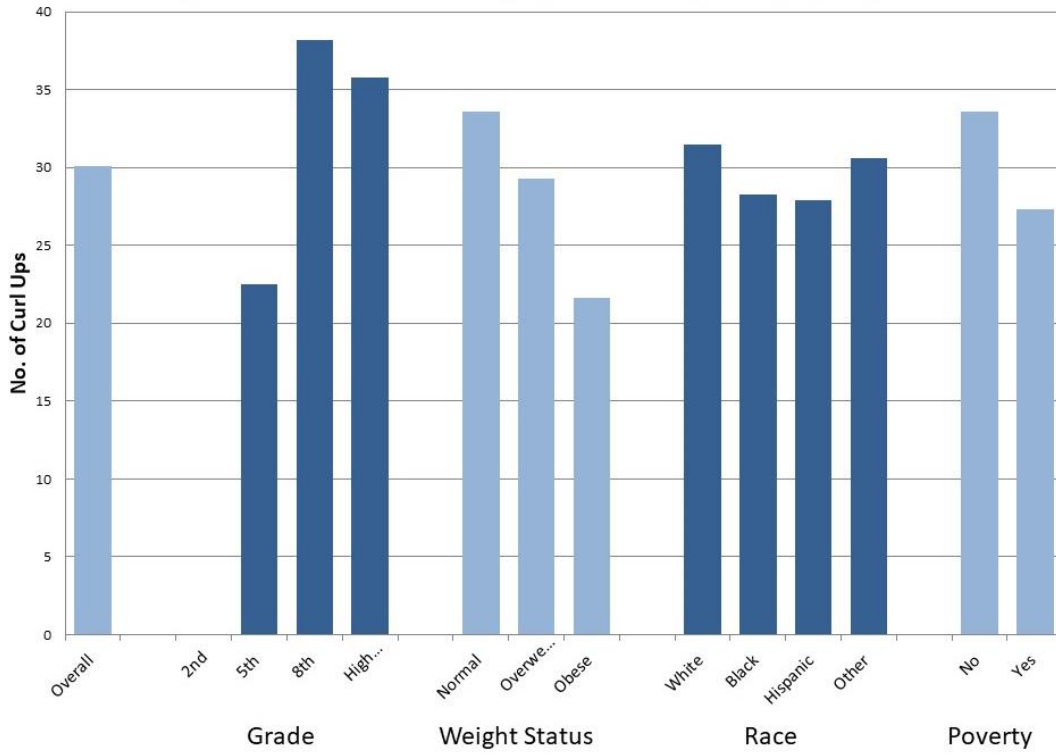
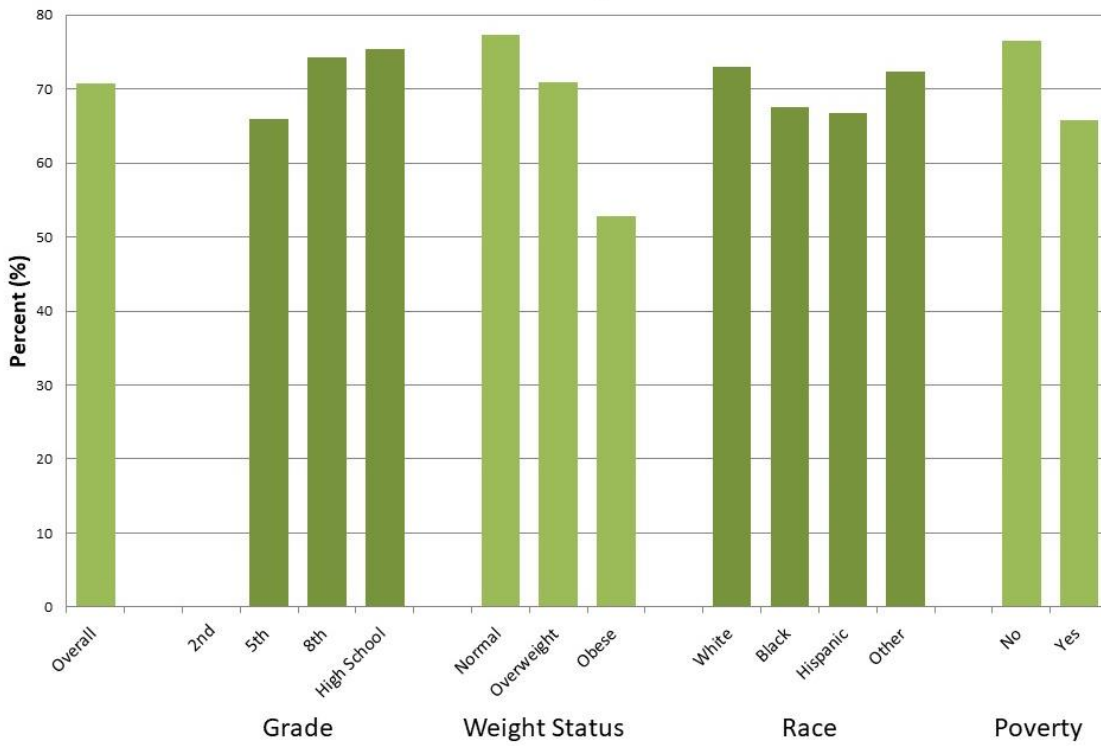


Figure 4d. Abdominal Muscular Strength/Endurance – Curl-Ups, Percent Attaining Healthy Fitness Zone, Boys



Key Findings and Conclusions

A key finding of the assessment of abdominal muscular strength and endurance was that approximately 70% of South Carolina students attained the Healthy Fitness Zone for curl-ups.

The following patterns were observed:

- Overall, the percentage of students scoring in the Healthy Fitness Zone category for curl-ups was similar for boy and girls.
- Across grade levels, the percentage of girls and boys attaining the Healthy Fitness Zone increased with increasing grade level.
- The percentage of students attaining the Healthy Fitness Zone was lower in Black and Hispanic students than in White students. This difference was slightly more pronounced in girls than boys.
- Performance on the abdominal muscular strength and endurance test was associated with weight status such that a higher percentage of normal weight students attained the Healthy Fitness Zone than did those in the overweight or obese categories.
- The percentage of students attaining the Healthy Fitness Zone for abdominal strength and endurance was lower among students in poverty.

5. Trunk Extensor Strength and Flexibility – Trunk Lift

Definition. Muscular strength is the ability to generate force through contraction of the skeletal muscles and to apply that force to the body or to external objects. Muscular flexibility refers to the range of motion in a joint or series of joints and is influenced by the length and extensibility of the muscles that cross the joint. Trunk extensor strength and flexibility is a person's ability to contract the musculature of the low back and hamstrings while having adequate flexibility in the abdominal and hip flexor muscles to extend the torso.

Relationship to Health. Trunk extensor strength and flexibility is important in maintaining correct posture and lower back health. To maintain good low back health, individuals must have adequate strength in back extensor muscles and sufficient, but not excessive, flexibility of the low back, hamstrings, and hip flexor muscles. The strength and flexibility of the trunk extensor muscles affect an individual's ability to perform activities of daily living such as picking up and carrying objects.

Measures. The trunk lift is the recommended test item to assess trunk extensor strength and flexibility in the FitnessGram protocol. The objective of the trunk lift is to use the muscles of the back to lift the upper body off the floor in a controlled manner while keeping the neck in a neutral position. A ruler is then used to measure the distance from the floor to the student's chin. The test is scored in inches, with a maximum score of 12.

Variable for analysis. Performance on the trunk lift test for trunk extensor strength and flexibility is scored by measuring in inches the distance the student lifts her/his chin from the floor. Each student's score is then categorized into one of two Healthy Fitness Zone categories using age- and sex-specific criteria. The categories are: 1) Healthy Fitness Zone; 2) Needs Improvement.

Results: Trunk Extensor Strength and Endurance

Overall Sample. Approximately 56,000 students completed the trunk extensor strength and flexibility component of the FitnessGram protocol. In the total sample, which included girls and boys in grades 5, 8 and high school, the average distance that students were able to lift the upper body was 10.1 inches. Performance was similar among boys and girls, with girls

performing slightly better than boys. The total percentage of students scoring in the Healthy Fitness Zone for trunk extensor strength and endurance was 77.7% with more girls scoring in this zone than boys (79.7% vs. 74.7%, respectively) (Table 5a). Compared to the other FitnessGram test components, a greater percentage of students scored in the Healthy Fitness Zone. These findings suggest that three in every four South Carolina students has adequate trunk extensor strength and flexibility to maintain good health.

Table 5a. Trunk Extensor Strength – Trunk Lift, Total Sample and By Sex, South Carolina FitnessGram School Year 2016-2017

Trunk Extensor Strength Variables	Total		Males		Females	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Trunk Lift (mean, SD)	55,900	10.1 (2.3)	28,607	9.9 (2.3)	27,293	10.2 (2.2)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	43,135	77.2%	21,378	74.7%	21,757	79.7%
Needs Improvement	12,765	22.8%	7,229	25.3%	5,536	20.3%

**trunk extensor strength was not assessed for 2nd grade students (n=30,167)*

Trunk Extensor Strength and Endurance in Girls. In girls, scores on the trunk lift were observed to increase from 5th grade to 8th grade and then decreased in high school. Overall, the percentage of students scoring in the Healthy Fitness Zone increased from 5th grade to high school (76.3% vs. 82.6%, respectively) (Table 5b). Across demographic groups, some differences in performance on the trunk lift test for trunk extensor strength and flexibility were observed (Figures 5a and 5b). Unlike results from the other FitnessGram test components, poorer performance on the trunk extensor strength and flexibility test was not observed in overweight and obese students compared to normal weight students. By race/ethnicity, performance on the trunk lift test was slightly lower in Black and Hispanic girls compared to White girls. Additionally, girls in poverty performed slightly worse compared to girls not living in poverty (Figures 5a and 5b).

Table 5b. Trunk Extensor Strength – Trunk Lift, Females By Grade, South Carolina
FitnessGram School Year 2016-2017

Trunk Extensor Strength Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Trunk Lift (mean, SD)	13,301	10.0 (2.3)	8,201	10.5 (2.0)	5,457	10.5 (2.1)
Healthy Fitness Zone	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	10,147	76.3%	6,824	83.2%	4,509	82.6%
Needs Improvement	3,154	23.7%	1,377	16.8%	948	17.4%

**trunk extensor strength was not assessed for 2nd grade students (n=30,167)*

Figure 5a. Trunk Strength/Endurance, Trunk Lift (mean), Girls

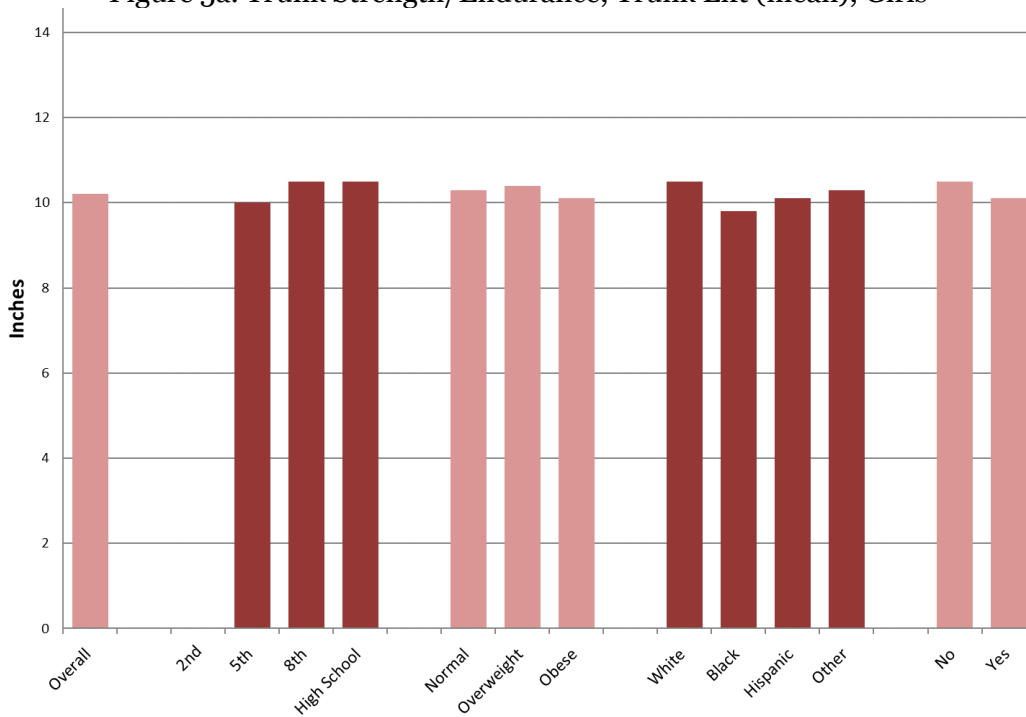
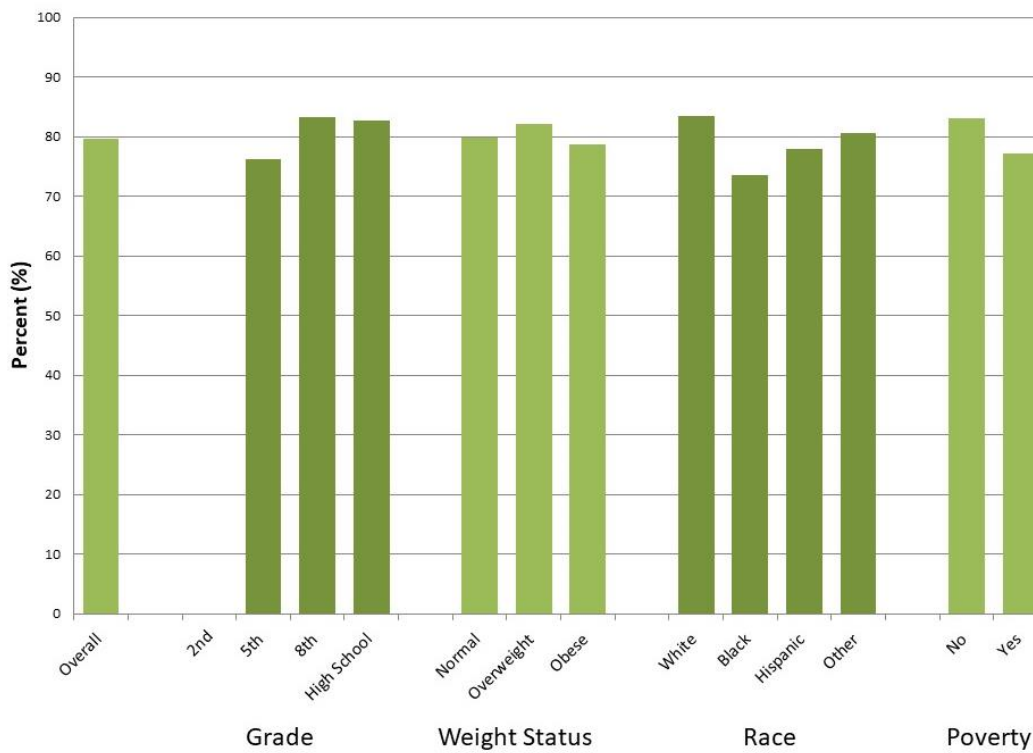


Figure 5b. Trunk Strength/Endurance – Trunk Lift, Percent Attaining Healthy Fitness Zone, Girls



Trunk Extensor and Endurance in Boys. Among boys, scores on the trunk lift were observed to increase from 5th grade to 8th grade and then were maintained in high school. The percentage of students scoring in the Healthy Fitness Zone increased from 70.9% in 5th grade to 77.8% in high school (Table 5c). Similar patterns across demographic groups were observed in boys and girls. Concerning weight status, poorer performance on the trunk extensor strength and flexibility test was not observed in overweight and obese students compared to normal weight students. By race/ethnicity, performance on the trunk lift test was slightly higher in White boys compared to other race/ethnicity groups. While less pronounced compared to other test components, poorer performance on the trunk extensor and endurance test was observed among male students in poverty (Figures 5c and 5d).

Table 5c. Trunk Extensor Strength – Trunk Lift, Males By Grade, South Carolina FitnessGram School Year 2016-2017

Trunk Extensor Strength Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Trunk Lift (mean, SD)	13,296	9.7 (2.3)	8,945	10.2 (2.2)	6,015	10.1 (2.4)
Healthy Fitness Zone	n	Percent	n	Percent	n	Percent
% Healthy Fitness Zone	9,423	70.9%	6,979	78.0%	4,681	77.8%
% Needs Improvement	3,873	29.1%	1,966	22.0%	1,334	22.2%

***trunk extensor strength was not assessed for 2nd grade students (n=30,167)*

Figure 5c. Trunk Strength/Endurance, Trunk Lift (mean), Boys

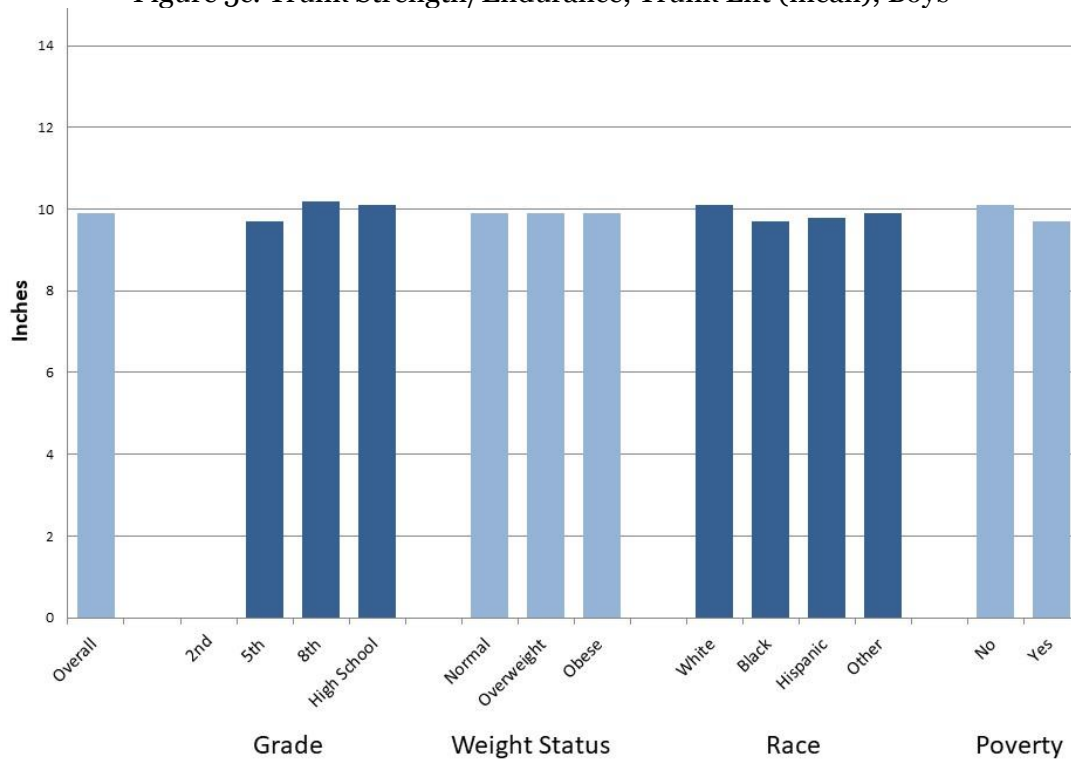
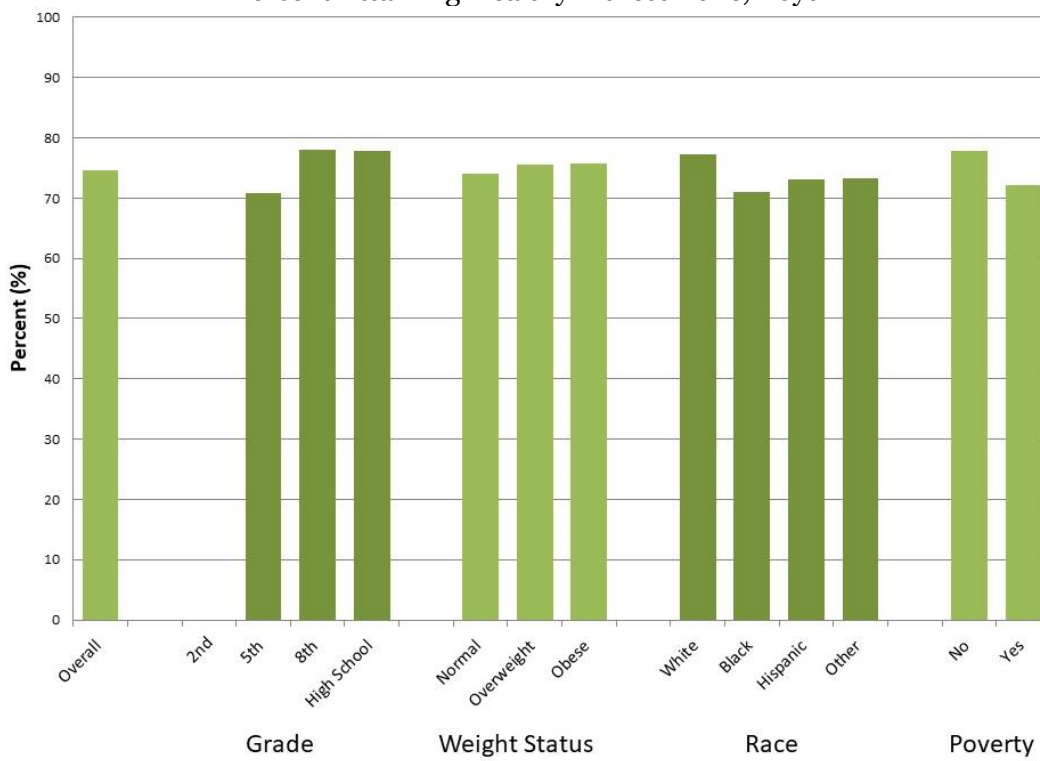


Figure 5d. Trunk Strength/Endurance – Trunk Lift, Percent Attaining Healthy Fitness Zone, Boys



Key Findings and Conclusions

A key finding of the assessment of trunk extensor strength and flexibility was that approximately 77% of South Carolina students attained the Healthy Fitness Zone for trunk lift.

The following patterns were observed:

- Overall, the percentage of students scoring in the Healthy Fitness Zone category for the trunk lift was slightly greater for girls than boys.
- Across grade levels, the percentage of girls and boys attaining the Healthy Fitness Zone was greater in 8th grade and high school than in 5th grade.
- The percentage of students attaining the Healthy Fitness Zone was lower in Black and Hispanic students than in White students. This difference was more pronounced in girls than boys.
- Performance on the trunk extensor strength and flexibility test was not associated with weight status; normal weight students tended to perform worse than overweight or obese students.
- Poorer performance on the trunk extensor and endurance test was observed among students in poverty. This pattern was less pronounced in the trunk extensor and endurance test component compared to the other test components.

6. Flexibility - Sit and Reach

Definition. Muscular flexibility refers to the range of motion in a joint or series of joints and is influenced by the length and extensibility of the muscles that cross the joint. The back-saver sit and reach test predominately is a measure of the hamstring muscles.

Relationship to Health. Maintaining an adequate level of flexibility is important for functional health and mobility. Some major benefits of adequate flexibility include reduced risk of injury and improved performance of daily activities. Normal hamstring flexibility allows for 1) proper rotation of the pelvis in forward bending movements; and 2) posterior tilting of the pelvis for proper sitting.

Measures. The back-saver sit and reach is the recommended test item to assess flexibility in the FitnessGram protocol. An alternate assessment test is the shoulder stretch. The majority of the students completing the FitnessGram protocol in South Carolina completed the sit and reach test. To perform the test, a student sits down at the test apparatus with one leg bent and the other fully extended. The arms are then extended forward over the measuring scale. The student then extends the opposite leg and repeats the test for the other side of the body. The objective of the test is to be able to reach the specified distance on both sides of the body. The test is scored in inches, with a maximum score of 12.

Variable for analysis. Performance on the sit and reach test for flexibility is scored by measuring in inches the distance the student is able to reach forward towards the extended foot. Two scores are taken; one for the right side of the body and one for the left side of the body. Each student's scores are then categorized into one of two Healthy Fitness Zone categories using age- and sex-specific criteria. The categories are: 1) Healthy Fitness Zone; 2) Needs Improvement. In order to be classified in the Healthy Fitness Zone category, a student must meet the standard on both the right and left side of the body.

Results: Flexibility

Overall Sample. Approximately 70,000 students completed the sit and reach test for flexibility. In the total sample, which included girls and boys in grades 5, 8 and high school, the average distance that students were able to reach forward was 9.8 inches. Performance was better among girls than boys. The total percentage of students scoring in the Healthy Fitness Zone for sit and reach was 61% and was similar among girls and boys (Table 6a).

Table 6a. Flexibility – Sit and Reach, Total Sample and By Sex, South Carolina FitnessGram School Year 2016-2017

Flexibility Variables	Total		Males		Females	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Sit and Reach, Left (mean, SD)	69,751	9.8 (2.5)	35,921	9.1 (2.6)	33,830	10.5 (2.1)
Sit and Reach, Right (mean, SD)	69,603	9.8 (2.5)	35,862	9.1 (2.6)	33,741	10.5 (2.1)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	49,701	61.0%	25,550	60.7%	24,151	61.2%
Needs Improvement	19,835	24.3%	10,273	24.4%	9,562	24.2%
Incomplete	11,210	13.8%	5,850	13.9%	5,360	13.6%
Exempt	785	1.0%	410	1.0%	375	1.0%

**flexibility was not assessed for 2nd grade students (n=30,167)*

Flexibility in Girls. Among girls, raw scores on the sit and reach test increased with increasing age and grade level. The percentage of girls scoring in the Healthy Fitness Zone increased from 5th grade to 8th grade then declined in high school (63.8% vs. 73.0% vs. 65.8%, respectively) (Table 6b). Across demographic groups, slight differences in performance on the sit and reach test were observed (Figures 6a and 6b). Slightly poorer performance on the sit and reach test for flexibility test was observed in overweight and obese students compared to normal weight students; Black and Hispanic girls compared to White girls; and students in poverty.

Table 6b. Flexibility – Sit and Reach, Females By Grade, South Carolina FitnessGram School
Year 2016-2017

Flexibility Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Sit and Reach, Left	16,076	10.1 (2.2)	9,623	10.8 (2.0)	7,605	10.9 (2.1)
Sit and Reach, Right	16,045	10.1 (2.2)	9,616	10.8 (2.0)	7,557	10.9 (2.0)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
Healthy Fitness Zone	11,068	63.8%	7,433	73.0%	5,281	65.8%
Needs Improvement	4,965	28.6%	2,170	21.3%	2,237	28.3%
Incomplete	1,104	6.4%	467	4.6%	421	5.3%
Exempt	217	1.3%	109	1.1%	49	0.6%

**flexibility was not assessed for 2nd grade students (n=30,167)*

Figure 6a. Flexibility, Sit and Reach (mean), Girls

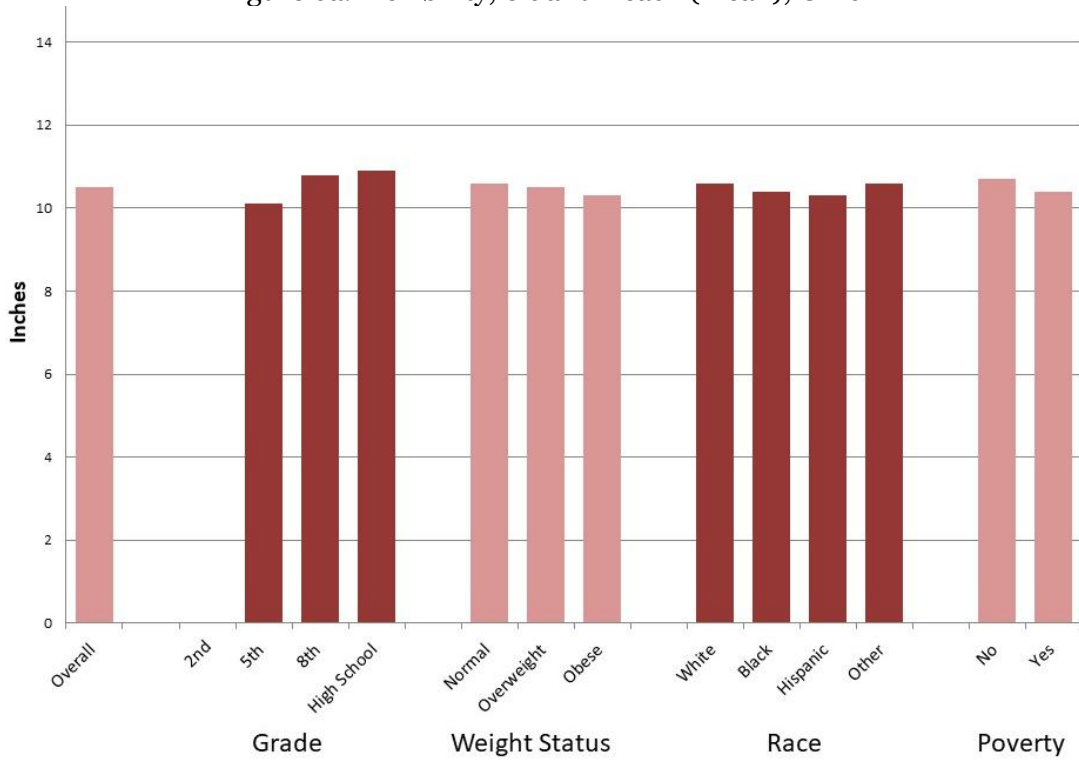
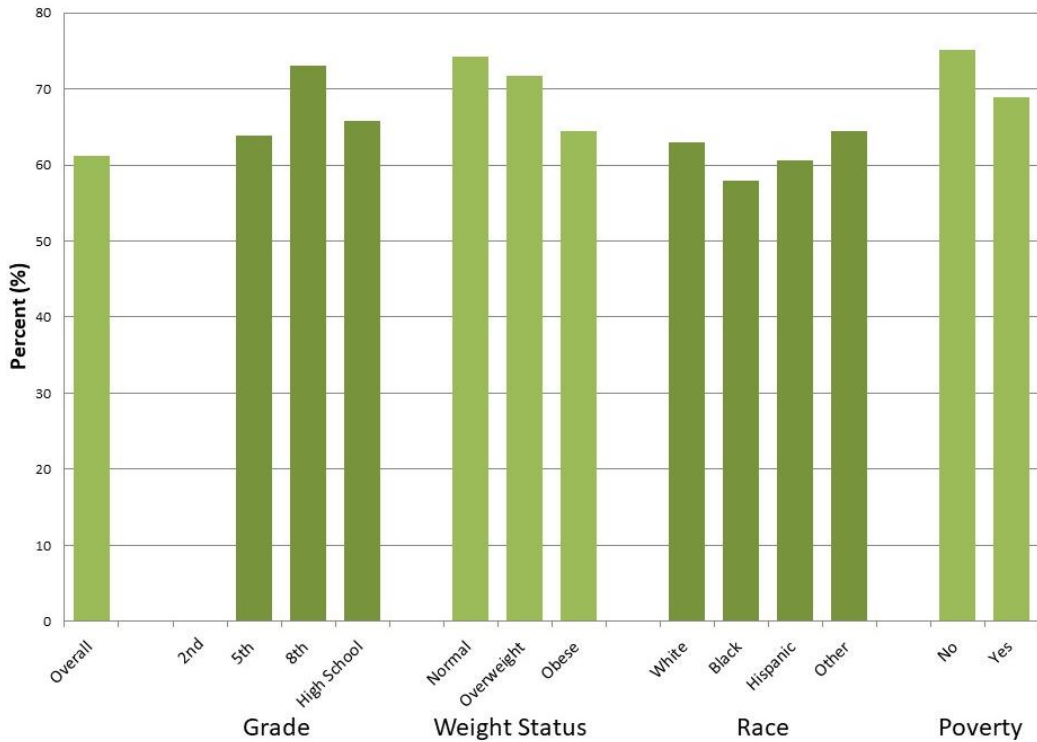


Figure 6b. Flexibility – Sit and Reach, Percent Attaining Healthy Fitness Zone, Girls



Flexibility in Boys. Similar to girls, raw scores on the sit and reach test for flexibility increased with increasing age and grade level. The percentage of boys attaining the Healthy Fitness Zone for flexibility also increased with increasing age and grade level (60.2% to 69.9% to 73.0%, respectively) (Table 6c). Additionally, similar patterns across demographic groups were observed in boys and girls. Concerning weight status, a lower percentage of overweight and obese boys compared to normal weight boys attained the Healthy Fitness Zone for flexibility. By race/ethnicity, performance on the sit and reach test was higher in boys of other race/ethnicity categories compared to all remaining groups (Figures 6c and 6d).

Table 6c. Flexibility – Sit and Reach; South Carolina FitnessGram; Males By Grade, School Year 2016-2017

Flexibility Variables	Grade					
	5 th Grade		8 th Grade		High School	
	n	Mean, SD	n	Mean, SD	n	Mean, SD
Sit and Reach, Left	16,103	8.7 (2.5)	10,564	9.4 (2.5)	8,722	9.6 (2.6)
Sit and Reach, Right	16,081	8.7 (2.5)	10,567	9.4 (2.5)	8,682	9.6 (2.6)
Healthy Fitness Zone Category	n	Percent	n	Percent	n	Percent
% Healthy Fitness Zone	10,527	60.2%	7,852	69.9%	6,787	73.0%
% Needs Improvement	5,545	31.7%	2,692	24.0%	1,888	20.3%
% Incomplete	1,164	6.7%	596	5.3%	557	6.0%
% Exempt	241	1.4%	96	0.9%	70	0.8%

**flexibility was not assessed for 2nd grade students (n=30,167)*

Figure 6c. Flexibility, Sit and Reach (mean), Boys

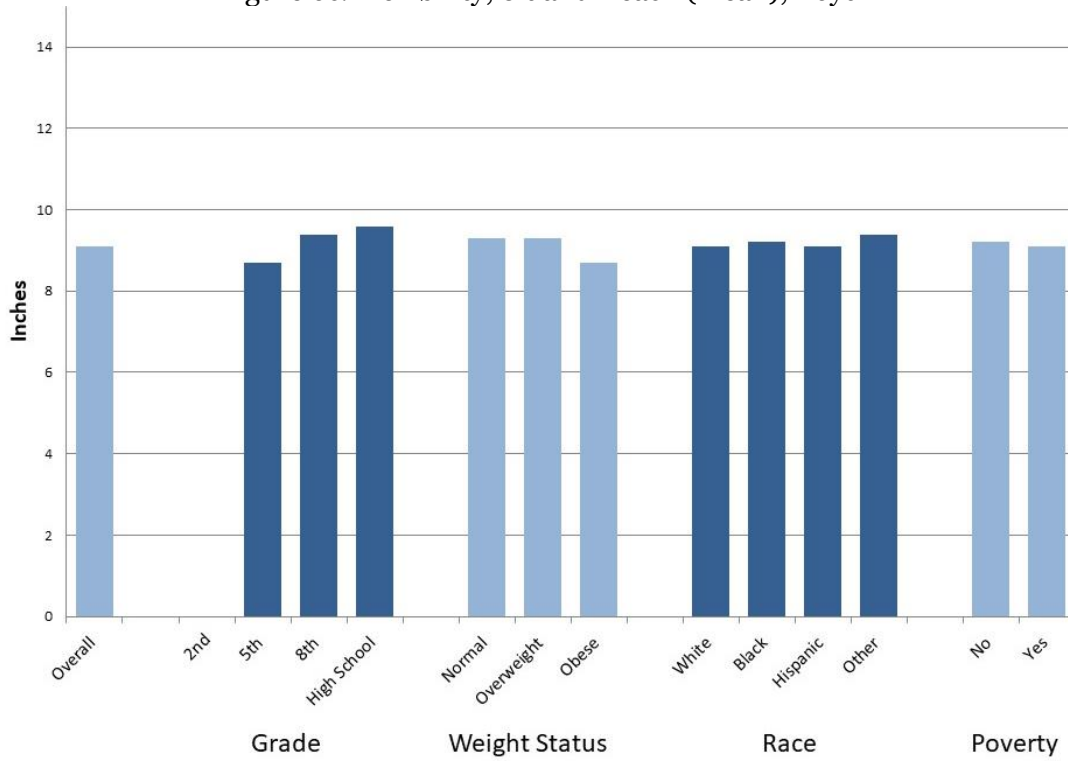
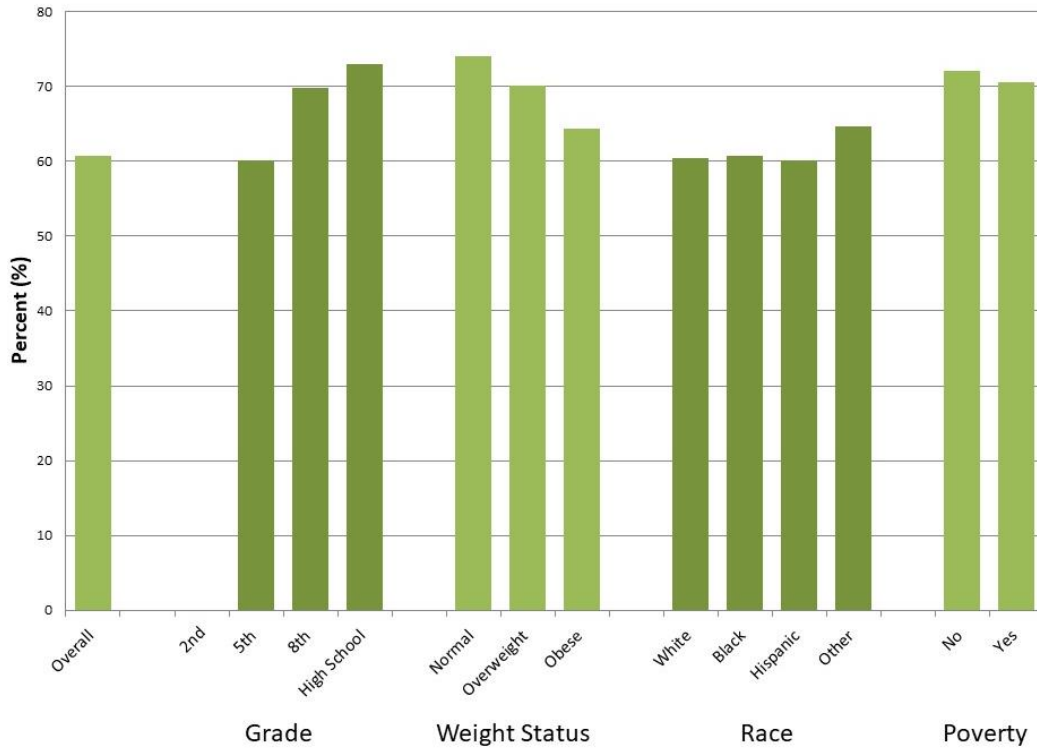


Figure 6d. Flexibility – Sit and Reach, Percent Attaining Healthy Fitness Zone, Boys



Key Findings and Conclusions

A key finding of the assessment of flexibility as measured by the sit and reach test was that approximately 61% of South Carolina students attained the Healthy Fitness Zone for flexibility.

The following patterns were observed:

- Overall, the percentage of students scoring in the Healthy Fitness Zone category for flexibility was similar among girls and boys.
- Across grade levels, the percentage of boys attaining the Healthy Fitness Zone increased with increasing grade level, while girls increased from 5th grade to 8th grade and then decreased in high school.
- The percentage of students attaining the Healthy Fitness Zone varied slightly across race/ethnicity groups and was different among girls and boys.
- Performance on the sit and reach test was associated with weight status; normal weight students tended to perform slightly better than overweight or obese students.
- Poorer performance on the sit and reach test for flexibility was observed among students in poverty. This pattern was less pronounced in boys compared to girls.

APPENDICES

Appendix A. Sample Distribution

Figure 1. Number of schools and school districts participating in the SC FitnessGram project by DHEC Public Health Region during school year 2016-2017.

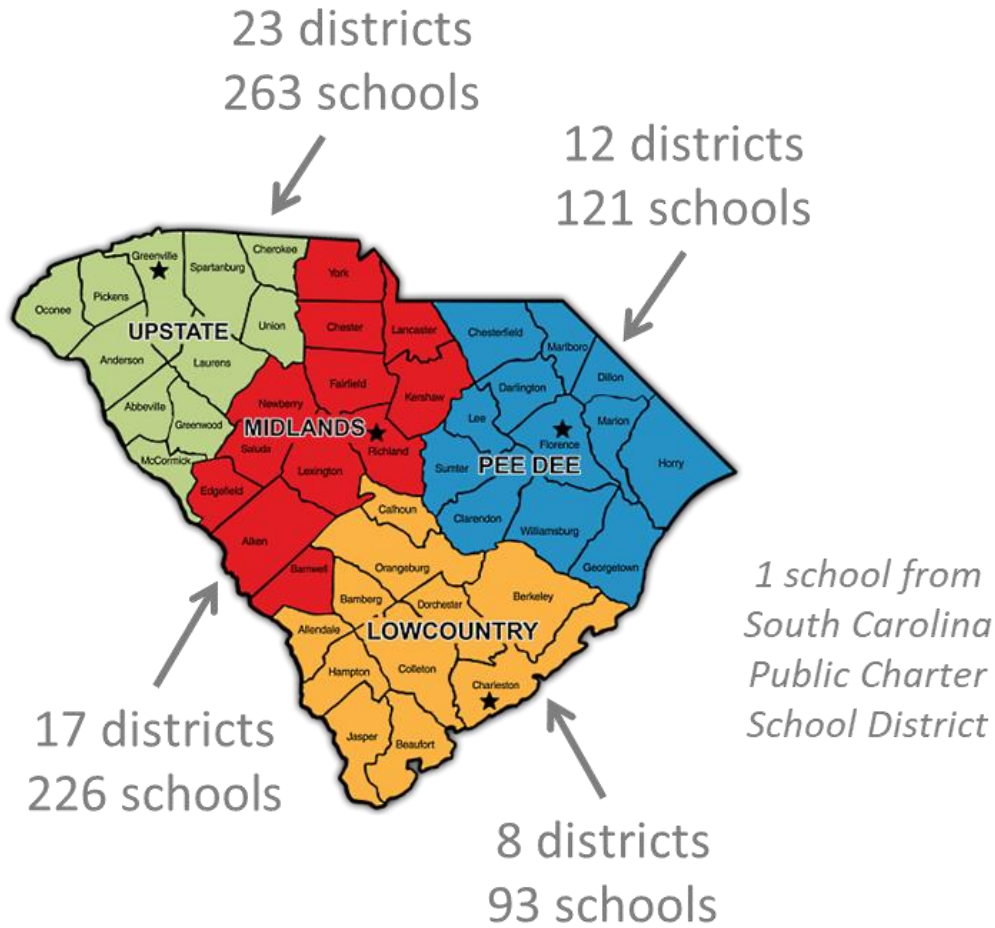


Table 1. Number of students, schools, and school districts participating in the SC FitnessGram project by DHEC Public Health Region during school year 2016-2017.

Health Region	Districts (n)	Schools (n)	Students*
Lowcountry	8	93	14,494
Midlands	17	226	34,061
Pee Dee	12	121	16,588
Upstate	23	263	43,681
TOTAL	60	703	108,875

*total number of students includes 51 students from 1 school in the South Carolina Public Charter School District.

Table 2. Number of students and schools participating in the SC FitnessGram project by school district and DHEC Public Health Region during school year 2016-2017.

Region	District	Schools (n)	Students (n)
Lowcountry	Bamberg School District 1	2	57
	Beaufort Co School District	26	3816
	Charleston Co School District	33	4622
	Dorchester Co School District 2	23	4961
	Hampton Co School District 1	1	130
	Hampton Co School District 2	1	104
	Jasper Co School District	2	235
	Orangeburg School District 4	5	569
	Total	93	14,494
Midlands	Aiken Co School District	29	3,470
	Barnwell School District 45	4	628
	Chester Co School District	5	623
	Clover School District 2	9	1,552
	Fairfield Co School District	6	394
	Kershaw Co School District	13	1,634
	Lancaster Co School District	17	2,745
	Lexington Co School District 1	29	5,455
	Lexington Co School District 3	3	188
	Lexington Co School District 4	2	438
	Newberry Co School District	10	967
	Richland Co School District 1	33	4,112
	Richland Co School District 2	34	7,042
	Rock Hill School District 3	22	3,560
	Saluda Co School District 1	3	295
	Williston School District 29	1	31
	York School District 1	6	927
	Total	226	34,061
	Pee Dee	Chesterfield Co School District	11
Clarendon School District 1		3	157
Clarendon School District 3		2	366
Darlington Co School District		8	689
Florence School District 1		19	3,200
Florence School District 2		1	48

	Georgetown Co School District	18	1,877
	Horry Co School District	28	4,973
	Marion County School District	4	346
	Marlboro Co School District	4	411
	Sumter School District	18	3,017
	Williamsburg Co School District	5	364
	Total	121	16,588
Upstate	Abbeville Co School District	7	534
	Anderson School District 1	14	2,194
	Anderson School District 2	6	684
	Anderson School District 3	5	648
	Anderson School District 4	4	554
	Anderson School District 5	10	1,717
	Cherokee Co School District	12	1,073
	Greenville Co School District	81	17,667
	Greenwood School District 50	10	1,729
	Laurens Co School District 55	7	797
	Laurens Co School District 56	5	602
	McCormick Co School District	3	199
	Oconee Co School District	12	1,551
	Pickens Co School District	21	3,362
	Spartanburg School District 1	10	1,024
	Spartanburg School District 2	15	2,434
	Spartanburg School District 3	4	320
	Spartanburg School District 4	3	504
	Spartanburg School District 5	5	1,106
	Spartanburg School District 6	13	2,991
	Spartanburg School District 7	6	860
	Union Co School District	8	944
	Ware Shoals School District 51	2	187
	Total	263	43,681
NA	SC Pubic Charter School District	1	51
	Total	1	51

Appendix B. Summary Tables for FitnessGram Results

Table 1. Summary of South Carolina FitnessGram Scores; Males & Females, School Year 2016-2017

Variable	Total (n=108,875)		Grade							
			2 nd Grade (n=30,167)		5 th Grade (n=37,283)		8 th Grade (n=22,756)		High School (n=18,669)	
	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD
Age (mean, SD)	108,875	11.1 (2.8)	30,167	7.6 (0.6)	37,283	10.5 (0.6)	22,756	13.6 (0.6)	18,669	14.8 (1.0)
Race/Ethnicity (%)	108,849									
American Indian (I)	301	0.3%	95	0.3%	112	0.3%	50	0.2%	44	0.2%
Asian (A)	1,757	1.6%	448	1.5%	562	1.5%	416	1.8%	331	1.8%
Black or African American (B)	33,335	30.6%	9,493	31.5%	11,294	30.3%	6,550	28.8%	5,995	32.1%
Hispanic or Latino (H)	10,700	9.8%	2,897	27.1%	3,956	10.6%	2,172	9.6%	1,675	8.8%
Hawaiian or Pacific Islander (P)	137	0.1%	31	0.1%	49	0.1%	36	0.2%	21	0.1%
White (W)	57,868	53.2%	15,662	51.9%	19,581	52.5%	12,630	55.5%	9,995	53.4%
Other/Unknown (M)	4,198	3.9%	1,335	4.4%	1,514	4.1%	765	3.4%	584	3.1%
Other/Unknown (?)	553	0.5%	202	0.7%	201	0.5%	132	0.6%	18	0.1%
Poverty Status (%)	108,228									
No	46,019	42.5%	11,339	37.9%	15,164	40.9%	10,652	47.1%	8,864	47.6%
Yes	62,209	57.5%	18,600	62.1%	21,879	59.1%	11,962	52.9%	9,768	52.4%
Height, ft (mean, SD)	95,290	4.9 (0.6)	29,591	4.2 (0.2)	31,819	4.8 (0.3)	18,713	5.4 (0.3)	15,167	5.5 (0.3)
Height, cm (mean, SD)	95,290	147.9 (16.9)	29,591	129.2(6.9)	31,819	146.5(8.4)	18,713	163.7 (8.5)	15,167	167.7 (9.1)
Weight, lbs (mean, SD)	95,290	103.3 (43.6)	29,591	65.7(17.3)	31,819	98.4(30.5)	18,713	135.6(38.1)	15,167	147.1(40.4)
Weight, kg (mean, SD)	95,290	46.9 (19.8)	29,591	29.8(7.8)	31,819	44.6(13.8)	18,713	61.5 (17.3)	15,167	66.7 (18.3)
Body Mass Index (FitnessGram)										
BMI (mean, SD)	95,290	20.6 (5.4)	29,591	17.7 (3.6)	31,816	20.5 (5.1)	18,711	22.8 (5.7)	15,167	23.7 (5.9)

% Healthy Fitness Zone	56,517	59.3 %	18,654	63.0%	17,712	55.7%	10,988	58.7%	9,163	60.4%
% Needs Improvement	15,604	16.4%	4,421	14.9%	5,488	17.3%	3,221	17.2%	2,474	16.3%
% Needs Improvement – Health Risk	19,251	20.2%	5,127	17.3%	7,309	23.0%	3,804	20.3%	3,011	19.9%
% Very Lean	3,913	4.1 %	1,389	4.7%	1,307	4.1%	698	3.7%	519	3.4%
Body Mass Index (CDC program)										
BMI (mean, SD)	95,290	20.6 (5.4)	29,591	17.7 (3.6)	31,819	20.5 (5.1)	18,713	22.8 (5.7)	15,167	23.7 (5.9)
Normal	60,488	63.5%	20,031	67.7%	19,053	59.9%	11,672	62.4%	9,732	64.2%
Overweight	15,587	16.4%	4,439	15.0%	5,451	17.1%	3,251	17.4%	2,446	16.1%
Obese	19,215	20.2%	5,121	17.3%	7,315	23.0%	3,790	20.3%	2,989	19.7%
Cardiorespiratory Fitness										
Estimated VO ₂ max (mean, SD)	71,715	42.0 (6.5)	0		34,731	42.1 (5.5)	20,682	41.9 (7.1)	16,302	41.7 (7.6)
% Healthy Fitness Zone	36,641	51.1%	--	--	18,820	54.2%	10,153	49.1%	7,668	27.0%
% Needs Improvement	17,375	24.2%	--	--	10,507	30.3%	3,996	19.3%	2,872	17.6%
% Needs Improvement – Health Risk	17,699	24.7%	--	--	5,404	15.6%	6,533	31.6%	5,762	35.4%
Mile - Estimated VO ₂ max (mean, SD)	3,745	44.6 (6.4)	--	--	676	44.9 (5.7)	468	44.5 (6.1)	2601	43.6 (6.3)
Pacer - Estimated VO ₂ max (mean, SD)	67,752	41.8 (6.5)	--	--	34,055	42.1 (5.5)	20,161	41.9 (7.1)	13,536	40.1 (7.1)
Walk - Estimated VO ₂ max (mean, SD)	218	41.8 (7.1)	--	--	--	--	53	40.1 (3.9)	164	39.6 (7.8)
Upper Body Strength/Endurance										
Push Ups (mean, SD)	69,692	11.3 (8.6)	--	--	32,504	9.4 (8.1)	20,514	12.8 (8.7)	15,929	13.5 (8.8)
% Healthy Fitness Zone	40,991	58.8 %	--	--	18,049	55.5%	12,931	63.0%	9,609	60.9%
% Needs Improvement	28,701	41.2%	--	--	14,455	44.5%	7,583	37.0%	6,320	39.7%
Modified Pull Up (mean, SD)	785	3.4 (3.9)	--	--	436	2.3 (3.0)	230	5.8 (3.6)	56	5.4 (6.1)
% Healthy Fitness Zone	243	31.0%	--	--	82	18.8%	141	61.3%	17	30.4%
% Needs Improvement	542	69.0%	--	--	354	81.2%	89	38.7%	39	69.6%
% Exempt	--	--	--	--	--	--	--	--	--	--

Flexed Arm Hang (mean, SD)	1,309	10.5 (12.7)	--	--	987	10.5 (12.9)	169	10.3 (13.6)	57	7.9 (8.8)
% Healthy Fitness Zone	954	71.9%	--	--	703	71.2%	117	69.2%	53	93.0%
% Needs Improvement	341	26.1%	--	--	272	27.6%	50	29.6%	4	7.0%
% Incomplete	14	1.1%	--	--	12	1.2%	2	1.2%	0	0.0%
Upper Body Strength HFZ										
% Healthy Fitness Zone	41,466	51.5%	--	--	18,359	52.8%	12,998	60.1%	9,620	57.8%
% Needs Improvement	28,756	35.7%	--	--	14,493	41.7%	7,537	34.9%	6,310	37.9%
% Incomplete	9,437	11.7%	--	--	1,519	4.4%	796	3.7%	537	3.2%
% Exempt	834	1.0%	--	--	382	1.1%	285	1.3%	166	1.0%
Abdominal Strength/Endurance										
Curl Ups (mean, SD)	72,755	27.5 (20.1)	--	--	33,754	21.4 (17.5)	21,041	34.5 (21.7)	16,771	32.1 (18.9)
% Healthy Fitness Zone	50,329	69.2%	--	--	21,594	64.0%	15,448	73.4%	12,509	74.6%
% Needs Improvement	22,426	30.8%	--	--	12,160	36.0%	5,593	26.6%	4,262	25.4%
Trunk Extensor Strength										
Trunk Lift (mean, SD)	55,900	10.1 (2.3)	--	--	26,597	9.8 (2.3)	17,146	10.4 (2.1)	11,472	10.3 (2.3)
% Healthy Fitness Zone	43,135	77.2%	--	--	19,570	73.6%	13,803	80.5%	9,190	80.1%
% Needs Improvement	12,765	22.8%	--	--	7,027	26.4%	3,343	19.5%	2,282	19.9%
Flexibility										
Sit and Reach, Left (mean, SD)	69,751	9.8 (2.5)	--	--	32,179	9.4 (2.4)	20,187	10.1 (2.4)	16,327	10.2 (2.4)
Sit and Reach, Right (mean, SD)	69,603	9.8 (2.5)	--	--	32,126	9.4 (2.4)	20,183	10.1 (2.4)	16,239	10.2 (2.4)
% Healthy Fitness Zone	49,701	61.0%	--	--	21,595	62.0%	15,285	71.4%	12,068	69.7%
% Needs Improvement	19,835	24.3%	--	--	10,510	30.2%	4,862	22.7%	4,161	24.0%
% Incomplete	11,210	13.8%	--	--	2,268	6.5%	1,063	5.0%	978	5.6%
% Exempt	785	1.0%	--	--	458	1.3%	205	1.0%	119	0.7%

Shoulder Stretch, Right (mean, SD)	2,944	0.8 (0.4)	--	--	1708	0.8 (0.4)	547	0.9 (0.3)	649	0.8 (0.4)
Shoulder Stretch, Left (mean, SD)	2,937	0.8 (0.4)	--	--	1701	0.9 (0.3)	547	0.9 (0.3)	649	0.8 (0.4)
% Healthy Fitness Zone	2,203	60.9%	--	--	1,265	65.4%	437	71.5%	475	65.2%
% Needs Improvement	734	20.3%	--	--	436	22.5%	110	18.0%	174	23.9%
% Incomplete	670	18.5%	--	--	221	11.4%	63	10.3%	80	11.0%
% Exempt	13	0.4%	--	--	12	0.6%	1	0.2%	0	0.0%
Flexibility HFZ										
% Healthy Fitness Zone	759	42.9%	--	--	589	51.0%	65	33.3%	21	26.3%
% Needs Improvement	563	31.8%	--	--	410	35.5%	104	53.3%	36	45.0%
% Incomplete	423	23.9%	--	--	139	12.0%	18	9.2%	23	28.8%
% Exempt	25	1.4%	--	--	17	1.5%	8	4.1%	0	0.0%

Table 2. Summary of South Carolina FitnessGram Scores; Males, School Year 2016-2017

Variable	Total (n=55,730)		Grade							
			2 nd Grade (n=15,237)		5 th Grade (n=18,713)		8 th Grade (n=11,902)		High School (n=9,878)	
	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD
Age (mean, SD)	55,730	11.2 (2.8)	15,237	7.6 (0.6)	18,713	10.5 (0.6)	11,902	13.6 (0.6)	9,878	14.9 (1.0)
Race/Ethnicity (%)	55,720									
American Indian (I)	162	0.3%	50	0.3%	53	0.3%	31	0.3%	28	0.1%
Asian (A)	897	1.6%	232	1.5%	287	1.5%	196	1.7%	182	1.8%
Black or African American (B)	16,856	30.3%	4,758	31.2%	5,558	29.7%	3,330	28.0%	3,210	32.5%
Hispanic or Latino (H)	5,600	10.1%	1,515	9.9%	2,026	10.8%	1,147	9.6%	912	9.2%
Hawaiian or Pacific Islander (P)	65	0.1%	13	0.1%	18	0.1%	19	0.2%	15	0.2%
White (W)	29,775	53.4%	7,901	51.9%	9,926	53.1%	6,716	56.5%	5,232	53.0%
Other/Unknown (M)	2,072	3.7%	667	4.4%	725	3.9%	392	3.3%	288	2.9%
Other/Unknown (?)	293	0.5%	101	0.7%	114	0.6%	67	0.6%	11	0.1%
Poverty Status	55,396									
No	23,851	43.1%	5,798	38.3%	7,616	41.0%	5,725	48.4%	4,712	47.8%
Yes	31,545	56.9%	9,330	61.7%	10,962	59.0%	6,105	51.6%	5,148	52.2%
Height, ft (mean, SD)	48,986	4.9 (0.6)	14,940	4.3 (0.2)	15,937	4.8 (0.3)	9,838	5.5 (0.3)	8,271	5.7 (0.3)
Height, cm (mean, SD)	48,986	149.6 (18.2)	14,940	129.6 (6.8)	15,937	146.0 (8.1)	9,838	166.5 (8.9)	8,271	172.3 (8.2)
Weight, lbs (mean, SD)	48,986	104.9 (45.5)	14,940	65.8 (17.0)	15,937	96.4 (29.5)	9,838	137.4 (39.6)	8,271	153.2 (41.7)
Weight, kg (mean, SD)	48,986	47.6 (20.7)	14,940	29.9 (7.7)	15,937	43.8 (13.4)	9,838	62.3 (18.0)	8,271	69.5 (18.9)
Body Mass Index (FitnessGram)										
BMI (mean, SD)	48,986	20.4 (5.3)	14,940	17.6 (3.5)	15,937	20.3 (4.9)	9,838	22.3 (5.5)	8,271	23.3 (5.7)
% Healthy Fitness Zone	29,160	59.5%	9,433	63.1%	8,844	55.5%	5,857	59.6%	5,026	60.8%

% Needs Improvement	7,597	15.5%	2,198	14.7%	2,635	16.5%	1,519	15.4%	1,245	15.1%
% Needs Improvement – Health Risk	9,952	20.3%	2,586	17.3%	3,754	23.6%	1,973	20.1%	1,639	19.8%
% Very Lean	2,275	4.6%	723	4.8%	704	4.4%	487	5.0%	361	4.4%
Body Mass Index (CDC program)										
BMI (mean, SD)	48,986	20.4 (5.3)	14,940	17.6 (3.5)	15,937	20.3 (4.9)	9,838	22.3 (5.5)	8,271	23.3 (5.7)
Normal	31,457	60.2%	10,144	67.9%	9,561	60.0%	6,329	64.3%	5,423	65.6%
Overweight	7,607	15.5%	2,190	14.7%	2,648	16.6%	1,547	15.7%	1,222	14.8%
Obese	9,922	20.3%	2,606	17.4%	3,728	23.4%	1,962	19.9%	1,626	19.7%
Cardiorespiratory Fitness										
Estimated VO ₂ max (mean, SD)	37,336	43.8 (7.1)	--	--	17,507	43.2 (6.1)	10,899	44.2 (7.6)	8,930	44.4 (8.1)
% Healthy Fitness Zone	21,975	58.9%	--	--	10,825	61.8%	6,333	58.1%	4,817	53.9%
% Needs Improvement	6,742	18.1%	--	--	4,230	24.2%	1,363	12.5%	1,149	12.9%
% Needs Improvement – Health Risk	8,619	23.1%	--	--	2,452	14.0%	3,203	29.4%	2,964	33.2%
Mile - Estimated VO ₂ max (mean, SD)	2,361	46.5 (6.3)	--	--	355	46.9 (5.6)	317	46.2 (5.7)	1,689	46.5 (6.6)
Pacer - Estimated VO ₂ max (mean, SD)	34,880	53.6 (7.1)	--	--	17,152	43.1 (6.1)	10,555	44.2 (7.6)	7,173	43.9 (8.3)
Walk - Estimated VO ₂ max (mean, SD)	95	44.4 (7.9)	--	--	--	--	27	40.5 (3.4)	68	45.9 (8.6)
Upper Body Strength/Endurance										
Push Ups (mean, SD)	36,057	13.6 (9.1)	--	--	16,345	11.0 (8.6)	10,749	15.4 (9.0)	8,579	16.8 (8.7)
% Healthy Fitness Zone	21,912	60.7%	--	--	10,312	63.1%	6,521	60.7%	4,849	56.5%
% Needs Improvement	14,145	39.3%	--	--	6,033	36.9%	4,228	39.3%	3,730	43.5%
Modified Pull Up (mean, SD)	377	4.0 (4.0)	--	--	208	2.8 (3.3)	107	7.2 (3.2)	39	3.4 (4.4)
% Healthy Fitness Zone	119	31.6%	--	--	42	20.2%	70	65.4%	5	12.8%
% Needs Improvement	258	68.4%	--	--	166	79.8%	37	34.6%	34	87.2%
Flexed Arm Hang (mean, SD)	614	11.7 (13.5)	--	--	483	11.4 (13.6)	70	12.8 (16.0)	14	35.8 (10.1)

% Healthy Fitness Zone	488	73.0%	--	--	335	69.4%	55	78.6%	13	92.9%
% Needs Improvement	164	26.7%	--	--	146	30.2%	15	21.4%	1	7.1%
% Incomplete	2	0.3%	--	--	2	0.4%	0	0.0%	0	0.0%
Upper Body Strength HFZ										
% Healthy Fitness Zone	22,132	53.3%	--	--	10,447	59.9%	6,561	58.1%	4,851	54.1%
% Needs Improvement	14,170	34.1%	--	--	6,064	34.7%	4,196	37.1%	3,729	41.6%
% Incomplete	4,844	11.7%	--	--	754	4.3%	413	3.7%	302	3. %
% Exempt	403	1.0%	--	--	188	1.1%	130	1.2%	84	0.9%
Abdominal Strength/Endurance										
Curl Ups (mean, SD)	37,348	30.1 (20.9)	--	--	16,919	22.5 (18.1)	11,009	38.2 (22.0)	8,830	35.8 (18.9)
% Healthy Fitness Zone	26,387	70.7%	--	--	11,147	65.9%	8,178	74.3%	6,659	75.4%
% Needs Improvement	10,961	29.4%	--	--	5,772	34.1%	2,831	25.7%	2,171	24.6%
Trunk Extensor Strength										
Trunk Lift (mean, SD)	28,607	9.9 (2.3)	--	--	13,296	9.7 (2.3)	8,945	10.2 (2.2)	6,015	10.1 (2.4)
% Healthy Fitness Zone	21,378	74.7%	--	--	9,423	70.9%	6,979	78.0%	4,681	77.8%
% Needs Improvement	7,229	25.3%	--	--	3,873	29.1%	1,966	22.0%	1,334	22.2%
Flexibility										
Sit and Reach, Left (mean, SD)	35,921	9.1 (2.6)	--	--	16,103	8.7 (2.5)	10,564	9.4 (2.5)	8,722	9.6 (2.6)
Sit and Reach, Right (mean, SD)	35,862	9.1 (2.6)	--	--	16,081	8.7 (2.5)	10,567	9.4 (2.5)	8,682	9.6 (2.6)
% Healthy Fitness Zone	25,550	60.7%	--	--	10,527	60.2%	7,852	69.9%	6,787	73.0%
% Needs Improvement	10,273	24.4%	--	--	5,545	31.7%	2,692	24.0%	1,888	20.3%
% Incomplete	5,850	13.9%	--	--	1,164	6.7%	596	5.3%	557	6.0%
% Exempt	410	1.0%	--	--	241	1.4%	96	0.9%	70	0.8%
Shoulder Stretch, Right (mean, SD)										
Shoulder Stretch, Right (mean, SD)	1,451	0.8 (0.4)	--	--	819	0.8 (0.4)	269	0.8 (0.4)	347	0.8 (0.4)

Shoulder Stretch, Left (mean, SD)	1,447	0.8 (0.4)	--	--	815	0.8 (0.4)	269	0.8 (0.4)	347	0.8 (0.4)
% Healthy Fitness Zone	1,041	58.2%	--	--	576	61.3%	206	68.9%	248	64.3%
% Needs Improvement	406	22.7%	--	--	239	25.4%	63	21.1%	99	26.7%
% Incomplete	337	18.9%	--	--	121	12.9%	30	10.0%	39	10.1%
% Exempt	4	0.2%	--	--	4	0.4%	0	0.0%	0	0.0%
Flexibility HFZ										
% Healthy Fitness Zone	380	43.6%	--	--	305	59.4%	25	28.7%	9	24.3%
% Needs Improvement	243	27.9%	--	--	187	33.3%	45	51.7%	5	13.5%
% Incomplete	237	27.2%	--	--	61	10.9%	13	14.9%	23	62.2%
% Exempt	12	1.4%	--	--	8	1.4%	4	4.6%	0	0.0%

Table 3. Summary of South Carolina FitnessGram Scores; Females, School Year 2016-2017

Variable	Total (n=53,145)		Grade							
			2 nd Grade (n=14,930)		5 th Grade (n=18,570)		8 th Grade (n=10,854)		High School (n=8,791)	
	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD	n	Mean, SD
Age (mean, SD)	53,146	11.0 (2.7)	14,930	7.6 (0.5)	18,570	10.5 (0.5)	10,854	13.5 (0.6)	8,791	14.7 (0.9)
Race/Ethnicity (%)	53,129									
American Indian (I)	139	0.3%	45	0.3%	59	0.3%	19	0.2%	16	0.2%
Asian (A)	860	1.6%	216	0.5%	275	0.5%	220	2.0%	149	1.7%
Black or African American (B)	16,479	31.0%	4,735	31.7%	5,739	30.9%	3,220	29.7%	2,785	31.7%
Hispanic or Latino (H)	5,100	9.6%	1,382	9.3%	1,930	10.4%	1,025	9.4%	763	8.7%
Hawaiian or Pacific Islander (P)	72	0.1%	18	0.1%	31	0.2%	17	0.2%	6	0.1%
White (W)	28,093	52.9%	7,761	52.0%	9,655	52.0%	5,914	54.5%	4,763	54.2%
Other/Unknown (M)	2,126	4.0%	668	4.5%	789	4.3%	373	3.4%	296	3.4%
Other/Unknown (?)	260	0.5%	101	0.7%	87	0.5%	65	0.6%	7	0.1%
Poverty Status	52,832									
No	22,168	42.0%	5,541	37.4%	7,548	40.9%	4,927	45.7%	4,152	47.3%
Yes	30,664	58.0%	9,270	62.6%	10,917	59.1%	5,857	54.3%	4,620	52.7%
Height, ft (mean, SD)	46,304	4.8 (0.5)	14,651	4.2 (0.2)	15,882	4.8 (0.3)	8,875	5.3 (0.2)	6,896	5.3 (0.2)
Height, cm (mean, SD)	46,304	146.1 (15.2)	14,651	128.7 (6.9)	15,882	147.1 (8.6)	8,875	160.6 (6.9)	6,896	162.1 (6.70)
Weight, lbs (mean, SD)	46,304	101.6 (41.5)	14,651	65.5 (17.6)	15,882	100.4 (31.2)	8,875	133.7 (36.3)	6,896	139.7(37.4)
Weight, kg (mean, SD)	46,304	46.1 (18.8)	14,651	29.7 (8.0)	15,882	45.5 (14.2)	8,875	60.7 (16.5)	6,896	63.4 (17.0)
Body Mass Index (FitnessGram)										
BMI (mean, SD)	46,304	20.8 (5.6)	14,651	17.8 (3.7)	15,882	20.8 (5.2)	8,875	23.4 (5.8)	6,896	24.1 (6.0)

% Healthy Fitness Zone	27,357	59.1%	9,221	62.9%	8,868	55.9%	5,131	57.8%	4,137	60.0%
% Needs Improvement	8,007	17.3%	2,223	15.2%	2,853	18.0%	1,702	19.2%	1,229	17.8%
% Needs Improvement – Health Risk	9,299	20.1%	2,541	17.3%	3,555	22.4%	1,831	20.6%	1,372	19.9%
% Very Lean	1,638	3.5%	666	4.6%	603	3.8%	211	2.4%	158	2.3%
Body Mass Index (CDC program)										
BMI (mean, SD)	46,304	20.8 (5.6)	14,651	17.8 (3.7)	15,882	20.8 (5.2)	8,875	23.4 (5.8)	6,896	24.1 (6.0)
Normal	29,031	62.7%	9,887	67.5%	9,492	59.8%	5,343	60.2%	4,309	62.5%
Overweight	7,980	17.2%	2,249	15.4%	2,803	17.7%	1,704	19.2%	1,224	17.8%
Obese	9,293	20.1%	2,515	17.2%	3,587	22.6%	1,828	20.6%	1,363	19.8%
Cardiorespiratory Fitness										
Estimated VO ₂ max (mean, SD)	34,379	40.0 (5.1)	--	--	17,224	41.0 (4.5)	8,875	39.4 (5.4)	7,372	38.6 (5.5)
% Healthy Fitness Zone	14,666	42.7%	--	--	7,995	46.4%	3,820	39.1%	2,851	38.7%
% Needs Improvement	10,633	30.9%	--	--	6,277	36.4%	2,633	26.9%	1,723	23.4%
% Needs Improvement – Health Risk	9,080	26.4%	--	--	2,952	17.1%	3,330	34.0%	2,789	38.0%
Mile - Estimated VO ₂ max (mean, SD)	1,384	41.2 (4.9)	--	--	321	42.6 (4.8)	151	40.9 (5.2)	912	40.7 (4.8)
Pacer - Estimated VO ₂ max (mean, SD)	32,872	40.0 (5.1)	--	--	16,903	41.0 (4.5)	9,606	39.3 (5.4)	6,363	38.2 (5.6)
Walk - Estimated VO ₂ max (mean, SD)	123	39.8 (5.7)	--	--	--	--	26	39.7 (4.4)	97	39.8 (6.0)
Upper Body Strength/Endurance										
Push Ups (mean, SD)	33,635	8.8 (7.3)	--	--	16,159	7.7 (7.2)	9,765	9.9 (7.3)	7,350	9.6 (7.1)
% Healthy Fitness Zone	19,079	56.7%	--	--	7,737	47.8%	6,410	65.6%	4,760	65.6%
% Needs Improvement	14,556	43.3%	--	--	8,422	52.1%	3,355	34.4%	2,590	34.4%
Modified Pull Up (mean, SD)	408	2.9 (3.7)	--	--	228	1.9 (2.6)	123	4.5 (3.4)	17	10.0 (7.0)
% Healthy Fitness Zone	124	30.4%	--	--	40	17.5%	71	57.7%	12	70.6%
% Needs Improvement	284	69.6%	--	--	188	82.5%	52	42.3%	5	29.4%

Flexed Arm Hang (mean, SD)	695	9.4 (11.9)	--	--	504	9.6 (12.1)	99	8.6 (11.4)	43	4.7 (5.7)
% Healthy Fitness Zone	506	72.8%	--	--	368	73.0%	62	62.6%	40	93.0%
% Needs Improvement	177	25.5%	--	--	126	25.0%	35	35.4%	3	7.0%
% Incomplete	12	1.7%	--	--	10	2.0%	2	2.0%	0	0.0%
Upper Body Strength HFZ										
% Healthy Fitness Zone	19,334	49.7%	--	--	7,712	45.7%	6,437	62.4%	4,769	62.2%
% Needs Improvement	14,586	37.5%	--	--	8,429	48.7%	3,341	32.4%	2,581	33.7%
% Incomplete	4,593	11.8%	--	--	765	4.4%	383	3.7%	235	3.1%
% Exempt	431	1.1%	--	--	194	1.1%	155	1.5%	82	1.1%
Abdominal Strength/Endurance										
Curl Ups (mean, SD)	35,407	24.7 (18.9)	--	--	16,835	20.2 (16.8)	10,032	30.4 (20.7)	7,941	28.0 (18.1)
% Healthy Fitness Zone	23,942	67.6%	--	--	10,447	62.1%	7,270	72.5%	5,850	73.7%
% Needs Improvement	11,465	32.4%	--	--	6,388	37.9%	2,762	27.5%	2,091	26.3%
Trunk Extensor Strength										
Trunk Lift (mean, SD)	27,293	10.2 (2.2)	--	--	13,301	10.0 (2.3)	8,201	10.5 (2.0)	5,457	10.5 (2.1)
% Healthy Fitness Zone	21,757	79.7%	--	--	10,147	76.3%	6,824	83.2%	4,509	82.6%
% Needs Improvement	5,536	20.3%	--	--	3,154	23.7%	1,377	16.8%	948	17.4%
Flexibility										
Sit and Reach, Left (mean, SD)	33,830	10.5 (2.1)	--	--	16,076	10.1 (2.2)	9,623	10.8 (2.0)	7,605	10.9 (2.1)
Sit and Reach, Right (mean, SD)	33,741	10.5 (2.1)	--	--	16,045	10.1 (2.2)	9,616	10.8 (2.0)	7,557	10.9 (2.0)
% Healthy Fitness Zone	24,151	61.2%	--	--	11,068	63.8%	7,433	73.0%	5,281	65.8%
% Needs Improvement	9,562	24.2%	--	--	4,965	28.6%	2,170	21.3%	2,237	28.3%
% Incomplete	5,360	13.6%	--	--	1,104	6.4%	467	4.6%	421	5.3%
% Exempt	375	1.0%	--	--	217	1.3%	109	1.1%	49	0.6%
Shoulder Stretch, Right (mean, SD)										
Shoulder Stretch, Right (mean, SD)	1,493	0.8 (0.4)	--	--	889	0.8 (0.4)	278	0.9 (0.3)	302	0.8 (0.4)

Shoulder Stretch, Left (mean, SD)	1,490	0.8 (0.3)	--	--	886	0.9 (0.3)	278	0.9 (0.3)	302	0.8 (0.4)
% Healthy Fitness Zone	1,162	63.4%	--	--	689	69.3%	231	74.0%	227	66.2%
% Needs Improvement	328	17.9%	--	--	197	19.8%	47	15.1%	75	21.9%
% Incomplete	333	18.2%	--	--	100	10.1%	33	10.6%	41	12.0%
% Exempt	9	0.5%	--	--	8	0.8%	1	0.3%	0	0.0%
Flexibility HFZ										
% Healthy Fitness Zone	379	42.2%	--	--	284	47.8%	40	37.0%	12	27.9%
% Needs Improvement	320	35.6%	--	--	223	37.5%	59	54.6%	31	72.1%
% Incomplete	186	20.7%	--	--	78	13.1%	5	4.6%	0	0.0%
% Exempt	13	1.5%	--	--	9	1.5%	4	3.7%	0	0.0%

Appendix C. FitnessGram Significance Tables

Table 1. Weight Status – Statistical significance of Inter-Group Differences

Figure	Comparison	Girls	Boys
		P<.05=*/ NOT DIFFERENT=NS	P<.05=*/ NOT DIFFERENT=NS
BMI by grade	2/5 2/8 2/9 5/8 5/9 8/9	* * * * * *	* * * * * *
BMI HFZ by grade	2/5 2/8 2/9 5/8 5/9 8/9	* * * * * *	* * * * * NS
BMI by Race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	* * * * * NS	* * * * * NS
BMI HFZ by Race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	NS * * * * *	* NS * * * *
BMI by Poverty	No Yes	* *	* *

HFZ=Health Fitness Zone

Table 2. Cardiorespiratory Fitness (CRF)- Statistical Significance of Inter-Group Differences

Figure	Comparison	Girls	Boys
		P<.05=*/ NOT DIFFERENT=NS	P<.05=*/ NOT DIFFERENT=NS
CRF by grade	5/8 5/9 8/9	* * *	* * NS
CRF HFZ by grade	5/8 5/9 8/9	* * NS	* * *
CRF by Weight status	Normal/Overweight Normal/Obese Overweight/Obese	* * *	* * *
CRF HFZ by Weight status	Normal/Overweight Normal/Obese Overweight/Obese	* * *	* * *
CRF by Race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	* * * NS * *	* * * NS * NS
CRF HFZ by Race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	* * * NS * *	* * * * * NS
CRF by poverty	No Yes	* *	* *
CRF HFZ by poverty	No Yes	* *	* *

HFZ=Health Fitness Zone

Table 3. Upper Body Strength- Statistical Significance of Inter-Group Differences

Figure	Comparison	Girls	Boys
		P<.05=*/ NOT DIFFERENT=NS	P<.05=*/ NOT DIFFERENT=NS
Pushup by grade	5/8	*	*
	5/9	*	*
	8/9	*	*
HFZ by grade	5/8	*	*
	5/9	*	*
	8/9	NS	*
Pushup by Weight status	Normal/Overweight	*	*
	Normal/Obese	*	*
	Overweight/Obese	*	*
HFZ by Weight status	Normal/Overweight	*	*
	Normal/Obese	*	*
	Overweight/Obese	*	*
Pushup by race	Black/Hispanic	NS	*
	Black/ Other	*	NS
	Black / White	*	NS
	Hispanic / Other	*	*
	Hispanic/White	*	*
	Other/White	NS	NS
HFZ by race	Black/Hispanic	NS	*
	Black/ Other	*	NS
	Black / White	*	*
	Hispanic / Other	*	*
	Hispanic/White	*	*
	Other/White	NS	NS
Pushup by poverty	No	*	*
	Yes		
HFZ by poverty	No	*	*
	Yes		

HFZ=Health Fitness Zone

Table 4. Trunk Extensor Strength- Statistical Significance of Inter-Group Differences

Figure	Comparison	Girls	Boys
		P<.05=*/ NOT DIFFERENT=NS	P<.05=*/ NOT DIFFERENT=NS
By grade	5/8 5/9 8/9	* * NS	* * *
HFZ by grade	5/8 5/9 8/9	* * NS	* * NS
By Weight status	Normal/Overweight Normal/Obese Overweight/Obese	* * *	NS NS NS
HFZ by Weight status	Normal/Overweight Normal/Obese Overweight/Obese	* * *	* * NS
By race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	* * * * * *	* * * NS * *
HFZ by race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	* * * NS * *	* NS * NS * *
By poverty	No Yes	* *	* *
HFZ by poverty	No Yes	* *	* *

HFZ=Health Fitness Zone;

Table 5. Flexibility – Statistical Significance of Inter-Group Differences

	Comparison	Girls		Boys	
		P<.05=*/NOT DIFFERENT=NS		P<.05=*/NOT DIFFERENT=NS	
		L	R	L	R
By grade	5/8	*	*	*	*
	5/9	*	*	*	*
	8/9	*	*	*	*
HFZ by grade	5/8	*		*	
	5/9	*		*	
	8/9	*		*	
By Weight status	Normal/Overweight	*	*	*	*
	Normal/Obese	*	*	*	*
	Overweight/Obese	*	*	*	*
HFZ by Weight status	Normal/Overweight	*		*	
	Normal/Obese	*		*	
	Overweight/Obese	*		*	
By race	Black/Hispanic	NS	NS	NS	NS
	Black/ Other	*	*	*	*
	Black / White	*	*	*	*
	Hispanic / Other	*	*	*	*
	Hispanic/White	*	*	NS	NS
	Other/White	NS	NS	*+	*
HFZ by race	Black/Hispanic	*		NS	
	Black/ Other	*		*	
	Black / White	*		NS	
	Hispanic / Other	*		*	
	Hispanic/White	*		NS	
By poverty	No	*	*	*	*
	Yes				
HFZ by poverty	No	*		*	
	Yes				

HFZ=Health Fitness Zone; R=Right; L=Left

Table 6. Abdominal Strength (Curl-ups)-Statistical Significance of Inter-Group Differences

Figure	Comparison	Girls	Boys
		P<.05=*/ NOT DIFFERENT=NS	P<.05=*/ NOT DIFFERENT=NS
By grade	5/8 5/9 8/9	* * *	* * *
HFZ by grade	5/8 5/9 8/9	* * NS	* * NS
By Weight status	Normal/Overweight Normal/Obese Overweight/Obese	* * *	* * *
HFZ by Weight status	Normal/Overweight Normal/Obese Overweight/Obese	* * *	* * *
By Race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	* * * * * *	NS * * * * NS
HFZ by Race	Black/Hispanic Black/ Other Black / White Hispanic / Other Hispanic/White Other/White	NS * * * * *	NS * * * * NS
By Poverty	No Yes	* *	* *
HFZ by poverty	No Yes	* *	* *

HFZ=Health Fitness Zone;