2014–15
and
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FOR THE TEXAS EDUCATION AGENCY

Assessment of the Relationship Between Physical Fitness and Student Academic and Non-Academic Outcomes

2014–15 and 2015–16

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Abdominal Muscular Strength and Endurance (Abdominal Strength)

Body Mass Index (BMI)

Disciplinary Alternative Education Erogram (DAEP)

End-of-course (EOC)

English language learner (ELL)

Every Student Succeeds Act (ESSA)

Free and Reduced Price Lunch (FRPL)

Healthy Fitness Zone (HFZ)

General Appropriations Act (GAA)

In-school suspensions (ISS)

Out-of-school suspensions (OSS)

Public Education Information Management System (PEIMS)

Physical Fitness Assessment Initiative (PFAI)

Request for Proposals (RFP)

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State of Texas Assessments of Academic Readiness (STAAR)

Texas Education Code (TEC)

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Trunk Extensor Muscular Strength and Endurance (Trunk Extensor Strength)

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Upper Body Muscular Strength and Endurance (Upper Body Strength)

Executive Summary

Background

The literature suggests that there is a positive correlation between physical fitness and various student outcomes. Thus it is important to understand the extent to which this relationship exists in Texas for academic outcomes, attendance, disciplinary outcomes, and related health outcomes. Studies examining the impact of physical fitness on student academic achievement report significant associations between physical fitness and student achievement (Bass, Brown, Laursen & Coleman, 2013; Blom, Alvarez, Zhang & Kolbo, 2011; Lambourne, Hansen, Szabo, Lee, Herrmann & Donnelly, 2013; Wittberg, Northrup & Cottrell, 2011; Van Dusen et al., 2011). Further, the aerobic capacity component of fitness may be the strongest predictor of student academic performance (Castelli et al., 2007; Rauner et al., 2013), and some studies suggest that the relationship may be stronger for mathematics (Chomitz et al., 2009; Eveland-Sayers, 2009; Lambourne, 2013; Van Dusen, 2011). However, the direct relationships between fitness and non-academic student outcomes (e.g., absenteeism and disciplinary action) have not been as extensively explored or published, and the results are generally mixed.

The fitness assessment tool utilized by the Texas Education Agency (TEA) is FitnessGram®. This assessment and reporting software program allows school districts to gather and report students' physical fitness data to the TEA. Created by The Cooper Institute, FitnessGram® includes the following six measures:

1. Aerobic Capacity
2. Upper Body Muscular Strength and Endurance (Upper Body Strength)
3. Abdominal Muscular Strength and Endurance (Abdominal Strength)
4. Trunk Extensor Muscular Strength and Endurance (Trunk Extensor Strength)
5. Flexibility
6. Body Composition

All Texas students in grades 3–12 enrolled in a physical education course or substitute activity must be assessed once annually using the FitnessGram® assessment instrument. Scores from the assessments are compared to Healthy Fitness Zone (HFZ) standards to determine students' overall physical fitness and suggest areas for improvement when appropriate. The HFZ standards are not based on class averages or any other peer comparisons. They are criterion referenced standards that are based on levels of fitness needed for good health.

To meet the requirements of Texas Education Code 38.104, Gibson Consulting Group (Gibson) conducted a thorough statewide analysis of physical fitness assessment data collected and submitted by Texas school districts. Gibson analyzed the relationship between FitnessGram® HFZ achievement and various student academic and non-academic outcomes. Student outcomes of interest included:

- Percentile rank on STAAR reading and STAAR mathematics
- Regular school day attendance rate

- Referrals for in-school suspensions (ISS) and out-of-school suspensions (OSS)
- Body Mass Index (BMI) percentile rank
- Body fat percentile rank
- Participation in the free or reduced price lunch (FRPL) program

The relationship between FitnessGram® HFZ measures and student outcomes are analyzed using descriptive, correlational, and multivariate statistical models (which adjust for differences in student characteristics, prior-year academic results, prior-year attendance, prior-year disciplinary results, school-level differences, and other factors). Descriptive results disaggregated by district, campus, grade, and gender, as well as district-level correlational results are available at:

http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data/

Key findings from the analyses are presented below.

Proportion of Texas Students Meeting Healthy Fitness Zone (HFZ) Thresholds

The evaluation team conducted analyses of the percentage of male and female students who met the HFZ for each of the six FitnessGram® measures. The number of students tested on the Aerobic Capacity measure was lower in both 2014–15 and 2015–16 than the other five FitnessGram® measures. The vast majority of both male and female students met the HFZ threshold for the Trunk Extensor Strength (85 to 88 percent), Abdominal Strength (79 to 81 percent), Upper Body Strength (73 to 75 percent), and Flexibility (73 to 79 percent) measures.

However, a lower proportion of male students were in the HFZ for Aerobic Capacity (64.4 percent in 2014–15 and 61.9 percent in 2015–16). This represents a 2.5 percentage point drop between the two school years. Similarly, 55.9 percent of female students were in the HFZ for Aerobic Capacity in 2014–15 and 53.3 percent met the threshold in 2015–16 (i.e., a 2.6 percentage point drop between years). The percentage of male and female students in the HFZ for Body Composition, measured most commonly by BMI, ranged from 60 to 64 percent for male and female students.

Approximately two-thirds of all tested male students in 2014–15 (66.3 percent) and 2015–16 (66.2 percent) achieved HFZ status in at least four of the six categories; however, a larger proportion of male students achieved HFZ status on all six FitnessGram® metrics in 2015–16 (18.2 percent) than did in 2014–15 (11.8 percent). Less than two percent of male students across the state did not meet HFZ thresholds on any of the six measures. Comparable results were observed for female students.

When results were disaggregated by school level (i.e., elementary, middle, and high school), interesting patterns related to the percentage of students in the HFZ emerged for some of the FitnessGram® measures. In both 2014–15 and 2015–16, a lower percentage of male and female high school students were in the HFZ for Aerobic Capacity than middle school and elementary schoolstudents. For male students, there is little variation by school level in the proportion of students in the HFZ for Body Composition between 2014–15 and 2015–16. However, for female students in 2014-15 the percentage of students in the Body Composition HFZ fluctuated from

62 percent in elementary school, to 62.8 percent in middle school, to 63.1 percent in high school. The 2015–16 results for female students again showed a higher proportion of high school students in the Body Composition HFZ than elementary and middle school female students.

Relationship Between FitnessGram® HFZ Metrics and Student Academic and Non-Academic Outcomes

First, the evaluation team at Gibson explored the bivariate correlational relationship between being in the HFZ for each of the FitnessGram® measures and the following five categories of student outcomes:

1) Academic outcomes (i.e., percentile rank on the STAAR mathematics and STAAR reading exams)
2) Attendance (i.e., regular school day attendance rate)
3) Obesity (i.e., percentile rank on the BMI)
4) Disciplinary outcomes (i.e., the number of ISS and OSS referrals and the incidence of a single ISS and OSS referral)
5) Economically disadvantaged status (i.e., being eligible for free or reduced priced lunch)

Relationship Between STAAR Results and FitnessGram® HFZ Status

Key findings from the correlational analyses are as described below. For these findings, a linear statistical association (or bivariate correlation) was calculated for each pair of variables. The statistic ranges from -1 (indicating a perfect negative correlation) to 0 (indicating no correlation) to 1 (indicating a strong positive correlation). Generally, a positive correlation is considered weak if it takes a positive value less than 0.4, moderate if it's between 0.4 and 0.7, and strong if it's 0.7 or greater (Hinkle, Wiersma, and Jurs 2003).[1] For correlations, statistical hypothesis tests were performed to assess the correlation observed significantly differs from zero.[2]

- The correlation between STAAR mathematics and STAAR reading percentile rankings and each of the six FitnessGram® measures was in the expected direction (i.e., higher levels of fitness correlated with better STAAR reading and mathematics results), but the

[1] Negative correlations are subject to these same thresholds of strength where negative correlations with a value between -0.4 and zero considered weak, correlations between -0.7 and -0.4 considered moderate, and correlations that are less than -0.7 considered strong negative correlations. These thresholds are used herein regardless of whether the correlation statistic is calculated using continuous indicators (Pearson's r correlation) or ordinal/skewed variables (Spearman's rank correlation).

[2] More precisely, the test of statistical significance for correlations calculates the probability of observing something as least as extreme as the correlational statistic conditional on the null hypothesis (that correlation is zero). A significant p-value (here, $p<0.05$) indicates that the correlation statistically significantly differs from zero.

correlational relationship was weak in both 2014–15 and 2015–16 with none of the Spearman correlation coefficients in excess of 0.15.

- The largest correlations among the six fitness metrics were between the Aerobic Capacity and Abdominal Strength measures and STAAR outcomes.

Relationship Between Attendance and FitnessGram® HFZ Status

- The correlation between attendance rate and each of the six FitnessGram® measures was in the expected direction (i.e., higher levels of fitness correlated with better regular school day attendance), but similar to the STAAR results, the statistical correlation was weak in both 2014–15 and 2015–16 with none of the Spearman correlation coefficients in excess of 0.15.
- Correlations between Aerobic Capacity and student attendance rates was much stronger (that is, larger in magnitude) than any of the other the six fitness metrics (Spearman correlation coefficients for Aerobic Capacity in 0.13 to 0.15 range compared to .06 for Abdominal Strength – the next highest).

Relationship Between Obesity Metrics and FitnessGram® HFZ Status

- With the exception of Trunk Extensor Strength, BMI percentile rank was negatively correlated with each of the FitnessGram® measures, meaning that as an increase in a student's BMI percentile rank (i.e., they are less fit) is negatively correlated with being in a HFZ.
- Negative correlations between the Aerobic Capacity (Spearman correlation coefficients of -0.32 and -0.40 in 2014–15 and 2015–16, respectively) and Upper Body Strength (Spearman correlation coefficients of -0.22 in both 2014–15 and 2015–16) measures and BMI were the largest in magnitude among the correlations between the six fitness metrics.

Relationship Between Disciplinary Referrals and FitnessGram® HFZ Status

- Achieving HFZ status and the number of ISS and OSS referrals a student received was a weak negative correlation (i.e., none of the Spearman correlation coefficients exceeded 0.08).
- Negative correlations between the Aerobic Capacity (Spearman correlation coefficients of -0.08 for ISS and -0.07 for OSS in 2014–15 and -0.06 for both in 2015–16) measure and the number of disciplinary referrals a student received were the largest among the six fitness metrics.

Relationship Between Eligibility for Free or Reduced Priced Lunch and FitnessGram® HFZ Status

- There was no statistically detectable correlation between being eligible for reduced priced lunch and meeting the HFZ threshold for any of the six fitness measures.

- However, a weak negative correlation was observed between being eligible for free lunch (i.e., a higher level of poverty) and being in a HFZ. That is, eligibility for free lunch was associated with a lower likelihood that a student would meet the HFZ threshold.
- The strongest correlation was found between BMI percentile rank and elebibility for free lunch (Spearman Correlation coefficient of 0.11)

Next, the evaluation team used multi-level regression models to further explore the statistical relationship between being in a HFZ and the same set of academic and non-academic outcomes described above in the correlational analyses. The multiple regression models controlled for differences in key student characteristics (e.g., demographic characteristics, socioeconomic status, prior academic achievement, prior attendance and disciplinary issues, populations of interest such as English Language learner (ELL) or special education, and school-level (e.g., school size, percentage of economically disadvantaged students enrolled) and estimated the effect of being in a HFZ with various student outcomes.The regression coefficient shown in these models is the statistical association between independent (or predictor) variables (e.g., student socioeconomic status) and the average change in some dependent (or outcome) variable (e.g., STAAR mathematics performance).

Relationship Between STAAR Results and FitnessGram® HFZ Status

- Being in the Aerobic Capacity HFZ was associated with a 1.35 percentage point increase in STAAR mathematics percentile ranking for male students in 2014–15 and a 1.17 percentage point increase in STAAR mathematics percentile ranking for female students in 2014–15. While directionally similar, the estimated effect was smaller in 2015-16 for both male and female students.
- For both male and female students, the next two FitnessGram® measures with the strongest relationship to STAAR mathematics percentile rankings were Abdominal Strength and Flexibility.
- Being in the Aerobic Capacity HFZ was associated with a 0.92 percentage point increase in STAAR reading percentile ranking for male students in 2014–15 and a 1.07 percentage point increase in STAAR reading percentile ranking for female students in 2014–15. In contrast to the findings for STAAR mathematics, being in the HFZ had a stronger association with reading results for female students than for male students.
- Similar to the results for mathematics, the next two FitnessGram® measures with the strongest relationship to STAAR reading percentile rankings were Abdominal Strength and Flexibility.
- The association between STAAR mathematics and STAAR reading percentile rankings and being in the Aerobic Capacity and Abdominal Strength HFZs was much stronger for high school students than middle school and elementary school students. For example, being a male high school student in the Aerobic Capacity HFZ was associated with a 2.4 and 2.7 percentage point increase for STAAR mathematics for high school students (in 2014–15 and 2015–16, respectively) and nearly two percentage points for STAAR reading (for both years). This is compared to associations between 1 and 1.4 percentage

point increases for elementary and middle school students. The same trend held for high school females, except the association was stronger for reading than mathematics.

- Improved fitness on Aerobic Capacity for male and female students between 2014–15 and 2015–16 was associated with increases in the percentile ranking in 2015–16 STAAR mathematics of approximately one percentage point. Improved fitness on Abdominal Strength was associated with about a three-quarter percentage point increase in STAAR mathematics percentile rank. Impacts on STAAR reading were more modest.

Relationship Between Attendance Rate and FitnessGram® HFZ Status

- Being in the HFZ for each of the FitnessGram® measures was associated with higher attendance rates; however, the relationships for all measures except Aerobic Capacity were weak.
- Being in the Aerobic Capacity HFZ was associated with a 0.27 to 0.30 percentage point increase in a male student's attendance rate and a 0.28 to 0.32 percentage point increase in a female student's attendance rate.
- Improved fitness on Aerobic Capacity for male and female students between 2014–15 and 2015–16 was associated with higher attendance rates (+0.15 percentage points for both male and female students). Changes in HFZ status for other measures were not associated with meaningful differences in regular school day attendance.
- While the impact may seem small in magnitude, it is important to remember that attendance rates average approximately 96 percent across the state so there is very little room to improve on this outcome measure.
- Similar to the findings for STAAR mathematics and STAAR reading, the relationship between HFZ attainment and student attendance rates tended to be stronger at the high school level, particularly for the Abdominal Strength and Trunk Extensor Strength measures. Some differences between male and female students were also observed when the findings were disaggregated by school level.

Relationship Between Obesity Metrics and FitnessGram® HFZ Status

- Being in the HFZ for Aerobic Capacity is associated with an increased likelihood that a male student will be in the Body Composition HFZ (typically measured by BMI) of 13 percentage points and an increased likelihood that a female student will be in the Body Composition HFZ of 11 percentage points.
- None of the other fitness metrics were related to Body Composition in a meaningful way.

Relationship Between Disciplinary Referrals and FitnessGram® HFZ Status

- Achieving Aerobic Capacity, Abdominal Strength, and Flexibility HFZ status and having an ISS and OSS referral in a particular school year were negatively correlated.

- For both male and female students, being in the Aerobic Capacity HFZ reduced the likelihood of having an ISS or OSS referral by 0.8 to 1.5 percentage points. The strength of the impact was lower for other fitness metrics.

Relationship Between Eligibility for Free or Reduced Priced Lunch and FitnessGram® HFZ Status

- Being economically disadvantaged is negatively associated with the likelihood of meeting the threshold for HFZ for all of the FitnessGram® measures. However, the strongest associations for both male and female students are in the Aerobic Capacity HFZ where being economically disadvantaged decreases the likelihood of males being in the HFZ for this measure by 1.6 percentage points and females by 4.6 percentage points.
- For all of the fitness measures examined in this analysis, the size of the estimated effect was larger for female students than male students.

Concluding Observations

Through the use of both bivariate correlational and multiple regression analyses, the strength of the statistical relationship between physical fitness metrics and student outcomes were found to be statistically significant and weak for most fitness metrics in both 2014–15 and 2015–16. However, they were directionally consistent with higher levels of physical fitness being associated with better academic outcomes (STAAR reading and STAAR mathematics percentile rankings), better school attendance, and fewer disciplinary referrals (ISS and OSS). In addition, higher percentile rank in BMI (i.e., an indicator of being less fit) was associated with a higher likelihood of being eligible for free meals, but not necessarily reduced-priced meals.

Further, the Aerobic Capacity HFZ measure consistently had the strongest association with better academic and non-academic student outcomes across all six measures in both 2014–15 and 2015–16. Further, the effects of being in various HFZs on STAAR mathematics, STAAR reading, and attendance rates tended to be more profound for high school students than middle school or elementary school students.

Chapter 1 – Introduction

Background

Authorized by Texas Education Code (TEC) §38.101-38.105 and General Appropriations Act (GAA), Article III, Rider 67 (84th Texas Legislature, Regular Session, 2015), the Texas Education Agency (TEA) requires that districts assess the fitness levels of all students in grades 3-12 enrolled in a physical education course, substitute course, or activity at least once annually and that school districts submit the results to TEA each school year. The required data analysis must address any correlation between the physical fitness assessment results received by the agency and student academic achievement, attendance, obesity, disciplinary problems, and school meal programs for each district.

In 2007, TEA identified FitnessGram® as the assessment tool to be used by all school districts. FitnessGram® is an assessment and reporting software program which allows schools to 1) gather physical fitness data from Texas students and 2) report data to TEA. The software was created by The Cooper Institute.

FitnessGram® includes the following six measures:

1. Aerobic Capacity
2. Upper Body Muscular Strength and Endurance (Upper Body Strength)
3. Abdominal Muscular Strength and Endurance (Abdominal Strength)
4. Trunk Extensor Muscular Strength and Endurance (Trunk Extensor Strength)
5. Flexibility
6. Body Composition

Scores from the assessments are compared to Healthy Fitness Zone (HFZ) standards to determine students' overall physical fitness and suggest areas for improvement when appropriate. The HFZ standards are not based on class averages or any other peer comparisons. The criterion referenced standards are based on levels of fitness needed for good health.

Schools are required to submit the results of the assessment to the TEA either through the web-based FitnessGram® software or TEA's Physical Fitness Assessment Initiative (PFAI) web application. The data collected from the physical fitness assessments are used to drive curriculum and health-related program improvements, which include healthy nutrition, increased self-esteem among students, appropriate professional development opportunities for school health professionals, and parental involvement.

In January 2017, through a competitive request for proposal (RFP) process, the TEA selected Gibson Consulting Group (Gibson) to conduct a comprehensive analysis of the relationship between students' physical fitness and both academic and non-academic outcomes. This report includes findings for the 2014–15 and 2015–16 school years.

Review of the Literature on the Relationship Between Physical Fitness/Physical Activity and Student Outcomes

In 2015, the United States Congress replaced the No Child Left Behind Elementary and Secondary Act (2001) with The Every Student Succeeds Act 2015 (ESSA), which identifies health and physical education as key components of a "well-rounded education" (Cooper, Greenberg, Castelli, Barton, Martin & Morrow, 2016). This followed a national trend of state legislators adopting legislation to target childhood obesity through statewide physical education and physical activity initiatives (Boehmer, Brownson, Haire-Joshu, & Dreisinger, 2007). Texas is no exception. A number of school-based physical education-related bills in Texas led up to the impetus for this *Assessment of the Relationship between Physical Fitness and Student Academic and Non-Academic Outcomes* project, culminating with legislation in 2007, Senate Bill (SB) 530, 80th Texas Legislature, Regular Session. (Morrow, Martin, Welk, Zhu & Merideth, 2010).

SB 530 mandated a host of requirements related to physical activity for school-aged children, including statewide health-related fitness testing and reporting for all students in grades 3–12. The last requirement of SB 530, Texas Education Code (TEC) §38.104, states that TEA "shall analyze [and report] the results [of physical fitness assessments provided by school districts] received by the agency under this subchapter and identify, for each school district, any correlation between the results and the following: student academic achievement levels; student attendance levels; student obesity; student disciplinary problems; and school meal programs." The five student outcomes are mapped directly into the research questions of the project.

The Relationship Between Physical Fitness and Student Outcomes

The current study explores the statistical relationships between fitness and the school-level indicators under Texas Education Code §38.104 (student academic achievement, student attendance, student obesity, student disciplinary problems, and student participation in school meal programs). In an analysis of 2011–2014 data, The Cooper Institute found that Texas schools with higher levels of HFZ attainment tended to have higher levels of academic achievement and higher attendance rates (Allums-Featherton, Bai & Wel, 2016).[3] The Cooper Institute stated that "the varied relationships make it difficult to draw definitive conclusions" and "[a]dditional research with individual measures offers potential to better understand the relationships." To delve more deeply into the relationships between HFZ attainment and the different academic and non-academic student outcomes, the research team has explored the relevant literature and applied more rigorous analytic methods to examine both school-level and student-level correlations.

Physical Fitness and Student Academic Achievement

Studies examining the impact of physical fitness on student academic achievement are generally consistent with The Cooper Institute's findings in Texas and report significant

[3] Results varied by test, grade, and age.

correlations between physical fitness and student achievement (Bass, Brown, Laursen & Coleman, 2013; Blom, Alvarez, Zhang & Kolbo, 2011; Lambourne, Hansen, Szabo, Lee, Herrmann & Donnelly, 2013; Wittberg, Northrup & Cottrell, 2011; Van Dusen et al., 2011). The Aerobic Capacity component of fitness may be the strongest predictor of student academic performance (Castelli, Hillman, Buck and Erwin, 2007; Rauner et al., 2013). Studies on physical fitness and achievement vary in the degree to which they examine differences in mathematics and reading test achievement; some suggest that the relationship may only be significant – or stronger – for mathematics (Chomitz et al., 2009; Eveland-Sayers, 2009; Lambourne, 2009; Van Dusen, 2011). Fitness studies also vary in the examination of how gender, age, grade-level, and socioeconomic status (SES) may affect the fitness-achievement relationship. Few have examined how the fitness-achievement relationship varies in different age groups, and the role of gender in the fitness-achievement relationship is unclear. While some studies find no gender differences, other studies suggest that the fitness-achievement relationship is stronger for female students (Bass et al., 2013; Van Dusen et al., 2013; London & Castrechini, 2009).

Physical Fitness and Student Obesity

Body mass index (BMI) is a measure of body composition used to assess if students are under-weight, normal weight, overweight, or obese. Unlike BMI for adults, BMI for children and teenagers is calculated as a BMI-for-age percentile that is sensitive to the developmental differences of age- and sex-specific growth charts (Centers for Disease Control, 2015).

A robust body of literature indicates that physical fitness is inversely related to obesity (Jin and Jones-Smith, 2015; Nikolaidis, 2013; Rauner, Mess and Wolf, 2013; Torrijos- Niño, 2014). Furthermore, in line with the current study's use of a multivariate analysis, research indicates that BMI is negatively associated with academic achievement (Castelli et al., 2007; Chomitz, Slining, McGowan, Mitchell, Dawson & Hacker, 2009). Obesity can also have implications for non-academic student outcomes; one study reported that overweight students were absent a significantly greater number of days than their normal-weight peers (Geier, Foster, Womble, McLaughlin, Borradaile, Nachmani, Sherman, Kumanyika & Shults, 2007).

Physical Fitness and Student Attendance and Disciplinary Problems

The direct relationships between fitness and non-academic student outcomes (e.g., absenteeism and disciplinary action) have not been extensively explored or published. Some studies have reported a dose-response relationship between an increase in physical fitness and a decrease in school absenteeism (Blom et al., 2011; D'Agostino, 2016). While literature on the relationship between fitness and disciplinary problems is more limited, one study failed to find any significant correlation between disciplinary action and fitness (Blom et al., 2011).

Physical Fitness and Student Participation in School Meal Programs

Several studies suggest students who participate in school meal programs are less physically fit than students who do not participate (Blom et al., 2011; Jin & Jones-Smith, 2015; London & Castrechini, 2009). As participation in school meal programs is often used as an indicator of SES, other researchers using FitnessGram® data have reported that a greater proportion of students with higher SES achieve higher FitnessGram® scores compared to their lower SES peers (Grissom, 2005).

Research Methods

Research Objectives

As part of this study, the evaluation team at Gibson addressed three primary research objectives:

1) Determine the percentage of students by district, campus, grade, and gender who attained the established Healthy Fitness Zone (HFZ) on each or all of the FitnessGram® tests and statewide and district-level correlations between FitnessGram® HFZ measures and student outcomes.
2) Determine the level of correlation between district-level HFZ metrics based on FitnessGram® data and student outcomes.
3) After controlling for student characteristics (e.g., prior academic performance, demographic and socioeconomic characteristics), determine the statistical association between student-level FitnessGram® data and student academic and non-academic outcomes.

The first research objective is addressed through descriptive analysis of aggregate PFAI data and student-level FitnessGram® data submitted by Texas school districts.[4] Results of the detailed analyses are summarized in Chapter 2 of this report, but have been reported to TEA in spreadsheet format and are available on the TEA website:

http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data/.

The second research objective was addressed through bivariate correlational analyses between the various fitness measures and student academic (e.g. STAAR mathematics and STAAR reading results), non-academic (attendance, disciplinary referrals), and health (obesity) outcomes at the statewide level and for school districts which submitted student-level data.

Lastly, for the third research objective, the evaluation team utilized multivariate statistical models to assess the statistical association between student-level FitnessGram® metrics and student academic and non-academic outcomes. Statistical models were run separately for male and female students, then again for male and female students enrolled in elementary, middle, and high schools.

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[4] In 2014–15, a total of 64 districts submitted aggregate data for 221 campuses, and a total of 26 districts in 2015–16 submitted aggregate data for 295 campuses. For each of the fitness tests, this dataset contained counts of the number of students tested and the number of students who are in the HFZ by campus, grade, and gender. In addition to the percentage of students in the HFZ, some measures also include the number and percentage of students at some risk and at high risk.

It is important to note that aggregate data submitted by local educational agencies (LEAs) could not be used in any of the correlational or multivariate analyses which required student-level records. Thus, the analysis dataset used for the analyses reported in Chapters 2 and 3 are based on student-level FitnessGram® records. In 2014–15, a total of 1,183 school districts reporting for 7,747 campuses submitted student level FitnessGram® records to TEA and 1,181 school districts reporting for 7,787 campuses submitted the data to TEA in 2015–16.

The following broad research questions are addressed in this study through correlational and multivariate analyses presented in Chapters 2 and 3:

- Research Question 1: Is there a relationship between HFZ attainment and STAAR Performance?
- Research Question 2: Is there a relationship between HFZ attainment and student attendance?
- Research Question 3: Is there a relationship between HFZ attainment and obesity?
- Research Question 4: Is there a relationship between HFZ attainment and disciplinary problems?
- Research Question 5: Is there a relationship between HFZ attainment and student participation in school meal programs?

Data Sources

The evaluation team accessed all data for this physical fitness assessment data analysis project at the University of Texas Education Research Center (UT-ERC). Access was granted to Gibson researchers on April 17, 2017. Datasets used to produce the results presented in this report include student-level demographic, attendance, and disciplinary data from the Public Education Information Management System (PEIMS), State of Texas Assessments of Academic Readiness (STAAR) data for the STAAR reading and STAAR mathematics exams, STAAR end-of-course (EOC) data, and FitnessGram® data. PEIMS, STAAR, and EOC data from 2013– 14, 2014– 15, and 2015– 16 were used in the analyses, as were 2014– 15 and 2015– 16 FitnessGram® data files. All students in grades 3–12 with valid, unique identifiers that could be used to match PEIMS records with STAAR/EOC assessment records and FitnessGram® data were included in the final analytic dataset.

Table 1.1 below provides a list of FitnessGram® measures used in the analyses. For each of the six FitnessGram® measures described in Table 1.1, there are 13 tests or assessments available to LEAs to gather several tests gather students' data. For example, to assess the aerobic measure of fitness, students may elect to complete a one-mile run, a one-mile walk, or a 20-meter shuttle run known as the PACER (Plowman & Meredith, 2013). Scores from the tests a categorize students into two primary zones, the Healthy Fitness Zone (HFZ) and Needs Improvement (NI) zone, which are age- and gender-specific. For evaluating aerobic fitness and body composition, a third category, the Needs Improvement – Health Risk Zone, also exists. The Cooper Institute establishedthe standards for the FitnessGram® measures with the use of nationally representative data (the Cooper Institute, n.d.).

Table 1.1. – Fitness Measurements and Component Assessments

Measure	Components
Aerobic Capacity	One-mile run, one-mile walk, or progressive aerobic cardiovascular endurance run (PACER)
Abdominal Muscular Strength and Endurance	Curl-up
Upper Body Muscular Strength and Endurance	Flexed arm hang, modified pull-up, or push up
Flexibility	Back saver sit and reach test or shoulder stretch
Trunk Extensor Strength	Trunk lift
Body Composition	Triceps and calf skinfold measurements, or BMI

Academic outcomes used in the statistical models include STAAR reading and STAAR mathematics exam scale scores for grades 3–8 and EOC results for grades 9–12.[5] Table 2 includes all academic outcome measures used in this study. Individual student-level exam scale scores for each subject-grade test were used in the models as academic outcomes of interest.

Table 1.2. – Academic Outcome Measures

Grade	Test
Grades 3–8	▪ Reading STAAR Test ▪ Mathematics STAAR Test
Grades 9–12	▪ Mathematics - Algebra I End-of-Course Exam - Algebra II End-of-Course Exam ▪ Reading - English I End-of-Course Exam - English II End-of-Course Exam

Research Approach

Bivariate Correlational Analyses

Gibson conducted a bivariate correlation analysis (which assessed the linear association between two variables of interest) to test each relationship outlined in the research questions. Correlation coefficients provide information on how two variables are related, and can vary from negative one to positive one. A negative correlation means that if one variable is higher, the other is generally lower; zero means there is no relationship between the two variables;

[5] Grade 8 students who were enrolled in Algebra I and took the EOC exam for that course are included in the Algebra I outcomes analyses.

and a positive one means that if one variable is higher, the other also tends to be higher. For example, a correlation coefficient of -0.80 between Aerobic Capacity and ISS would mean that students with better aerobic capacity have fewer ISS incidents (and the relationship is strong in magnitude), while a correlation coefficient of 0.22 would mean that on average we would expect that students with higher aerobic capacity have more ISS incidents, but the relationship is weak. While Pearson's correlation coefficients are more common, since most of the variables of interest are not continuous, but rather have categories, Spearman's correlation coefficients were calculated. Rather than using the raw number, with Spearman's correlation coefficient, those values are used to rank order the observations and correlation is calculated on rank orders.[6]

Multivariate Analyses

While bivariate correlations can be informative, multivariate modeling provides considerably more insight into the relationship between fitness and academic and non-academic outcomes. Our methodology took advantage of the rich, student-level records that are available at the ERC and that are collected by the FitnessGram® web application. With data, the research staff linked longitudinal student-level physical fitness data to longitudinal academic and behavioral outcomes. This was to explore associations between HFZ attainment and the outcome measures identified in Objective 2, after adjusting for incoming compositional differences in achievement or behavior between students who receive different fitness scores with a multivariate statistical model. Using this model, the research team estimated the relationship between fitness and academic outcomes that is separate from any relationship between other student characteristics, such as economic disadvantage and academic outcomes. Thus, the research team was able to make estimates based on associations between measures adjusted for malleable (e.g., prior test scores and fitness scores) and invariant (e.g., sex or race) student characteristics.[7]

Another factor that can influence estimates is that students are nested in schools. School-level conditions can also influence student outcomes. To account for this, the research team used a multilevel model, which includes school-level means for student characteristics to allow for inferences about both school- and individual-level fitness.[8] In addition to the statistical models

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[6] See Appendix B for additional detail on the calculation of Spearman's correlation coefficients.

[7] Our research design does not attempt to make causal inferences about the impact of physical fitness on student outcomes. This is intentional. Based on our team's understanding of the authorizing statue for this work, and the language included in the RFP, the intent of this work is not to make inferences about the impact of physical fitness on student outcomes (or vice versa). Nonetheless, we assessed these relationships in a multivariate regression framework to make stronger *conditional* statements about the association between student outcomes and physical fitness. For example, although student achievement may be differentially correlated with physical fitness ratings based on race or sex, this heterogeneous correlation may be an artifact of differences in *baseline* student achievement.

[8]See Rauner, R. R., Walters, R. W., Avery, M., & Wanser, T. J. (2013). Evidence that aerobic fitness is more salient than weight status in predicting standardized math and reading outcomes in fourth-through eighth-grade students. The Journal of Pediatrics, 163(2), 344-348.

used to account for school-level characteristics independent of student-level characteristics, Gibson also accounted for the students' prior performance on the outcomes of interest.[9] Models were run separately for male and female students, as the relationships between fitness and student outcomes differ by gender are often found and modeling them separately is most typical in the literature.[10]

Table 1.3 outlines the student academic and non-academic outcome variables, the covariates of substantive interest (i.e., fitness outcomes), and the other control variables (e.g., race/ethnicity, economically disadvantaged status, and school-level variables). In the control variables column, the t-1 subscript represents that variable's value in the prior year.

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[9] For years where the prior year's data is available and where student records can be linked across years.

[10] See the following for studies splitting the sample by gender: Haapala, E. A., Väistö, J., Lintu, N., Westgate, K., Ekelund, U., Poikkeus, A. M., ... & Lakka, T. A. (2016). Physical activity and sedentary time in relation to academic achievement in children. *Journal of Science and Medicine in Sport*, Bass, R. W., Brown, D. D., Laurson, K. R., & Coleman, M. M. (2013). Physical fitness and academic performance in middle school students. *Acta paediatrica*, *102*(8), 832-837, Kwak, L., Kremers, S. P., Bergman, P., Ruiz, J. R., Rizzo, N. S., & Sjöström, M. (2009). Associations between physical activity, fitness, and academic achievement. *The Journal of Pediatrics*, *155*(6), 914-918.

Table 1.3. – Research Questions and Their Outcomes, Covariates of Interest, and Other Covariates

Research Question	Academic and Non-Academic Outcomes	Covariates of Substantive Interest[11]	Control Variables[12]
2.1 Is there a relationship between HFZ attainment and STAAR performance?	STAAR mathematics percentile	Student-level measures of: Aerobic Capacity HFZ, Body Composition HFZ, Upper Body Strength and Endurance HFZ, Abdominal Strength and Endurance HFZ, Trunk Extensor Strength HFZ, and Flexibility HFZ	Student STAAR mathematics percentile_{t-1}, student race/ethnicity, student age, student economically disadvantaged status (free or reduced price lunch eligible), student special education status, student English language learner status, school percent with economic disadvantage, school size
	STAAR reading percentile	Student-level measures of: Aerobic Capacity HFZ, Body Composition HFZ, Upper Body Strength and Endurance HFZ, Abdominal Strength and Endurance HFZ, Trunk Extensor Strength HFZ, and Flexibility HFZ	Student STAAR reading percentile_{t-1}, student race/ethnicity, student age, student economically disadvantaged status, student special education status, student English language learner status, school percent with economic disadvantage, school size
2.2 Is there a relationship between HFZ attainment and student attendance rate?	Attendance rate	Student-level measures of: Aerobic Capacity HFZ, Body Composition HFZ, Upper Body Strength and Endurance HFZ, Abdominal Strength and Endurance HFZ, Trunk Extensor Strength HFZ, and Flexibility HFZ	Student attendance rate_{t-1}, student race/ethnicity, student age, student economically disadvantaged status, student special education status, student English language learner status, school percent with economic disadvantage, school size

[11] Each of these fitness covariates were measured at the student-level using FitnessGram® records. See Table 1.1 for definitions of each covariate.

[12] All models were run separately by year and gender. For definitions of these variables, please refer to Appendix B.

Research Question	Academic and Non-Academic Outcomes	Covariates of Substantive Interest[11]	Control Variables[12]
2.3. Is there a relationship between HFZ attainment and student obesity?	Body Composition HFZ	Student-level measures of: Aerobic Capacity HFZ, Upper Body Strength and Endurance HFZ, Abdominal Strength and Endurance HFZ, Trunk Extensor Strength HFZ, and Flexibility HFZ	Body composition HFZ_{t-1}, student race/ethnicity, student age, student economically disadvantaged status, student special education status, student English language learner status, school percent with economic disadvantage, school size
2.4. Is there a relationship between HFZ attainment and student disciplinary problems?	Student has ISS or OSS referrals	Student-level measures of: Aerobic Capacity HFZ, Upper Body Strength and Endurance HFZ, Abdominal Strength and Endurance HFZ, Trunk Extensor Strength HFZ, and Flexibility HFZ	Disciplinary $actions_{t-1}$, student race/ethnicity, student age, student economically disadvantaged status, student special education status, student English language learner status, school percent with economic disadvantage, school size
2.5. Is there a relationship between HFZ attainment and student participation in school meal programs?	Free or reduced price lunch status (economic disadvantaged status)	Student-level measures of: Aerobic Capacity, Body Composition, Upper Body Strength and Endurance, Abdominal Strength and Endurance, Trunk Extensor Strength, and Flexibility	Student race/ethnicity, student age, student special education status, student English language learner status, school percent with economic disadvantage, and school size

Results from the multivariate analysis are presented as the average difference between students achieving HFZ status and students who did not achieve this level of fitness on the six FitnessGram® HFZ metrics (i.e., the marginal effect), adjusting for differences on other attributes (e.g., student mathematics and reading achievement, gender, economic disadvantage status).

Organization of the Report

Following the introductory chapter, Chapter 2 provides descriptive and bivariate correlation results regarding the relationship between various physical fitness metrics and a variety of outcomes (i.e., STAAR reading and mathematics results, student attendance, BMI percentile, and participation in the Free or Reduced Priced Lunch [FRPL] program). Chapter 3 further explores the relationship between FitnessGram® HFZ metrics and student academic, school attendance, and disciplinary outcomes through the use of multi-level statistical models which control for differences in student characteristics and prior academic achievement to arrive at estimates of the impact of achieving HFZ status for the various FitnessGram® measures. Appendix A includes additional detail regarding the FitnessGram® and aggregate PFAI data used in this report and included in district/campus/grade/gender level descriptive results posted to the TEA website.[13] Appendix B provides technical detail related to how the FitnessGram®, PEIMS, and STAAR/EOC data were processed to develop an analysis dataset, how correlations were calculated, and how model specifications for the multi-level models were used to assess the relationship between fitness metrics and student outcomes. Appendix C includes detailed tables not included in the body of the report, including descriptive statistics, correlational tables, and full regression results from the statistical models used in this study.

[13] http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data/

Chapter 2 – Summary of Descriptive Results and Correlational Analyses

In this chapter, descriptive results related to the percentage of students who met the Healthy Fitness Zone (HFZ) thresholds for the six FitnessGram® metrics and statewide correlations between FitnessGram® HFZ metrics and student outcomes are presented. For the descriptive findings, statewide results are presented first, followed by results disaggregated by gender and school level (i.e., elementary, middle, and high school). The second portion of the chapter describes the statewide bivariate correlation results which examines the strength of the relationship between the six FitnessGram® HFZ metrics and both academic and non-academic outcomes.

Profile of Study Population

Descriptive results include students in Grades 3–12. A total of 2,163,000 students across all grades are included the 2014–15 results and 1,880,701 are included in the 2015–16 results. As a result of two large school districts shifting from student-level FitnessGram® data reporting in 2014-15 to aggregate PFAI reporting in 2015–16, the total number of students with FitnessGram® records dropped in 2015–16.[14]

It is also important to note that student participation in the FitnessGram® assessments varies substantially by grade level with students in elementary school participating at higher rates than students in middle school and students in high school. Further, the percentage of students with FitnessGram® records in high school ranged from 45 to 46 percent in 2014–15 and 36 to 37 percent in 2015–16 for students in grade 9 to just 15 to 19 percent for grade 12 students in 2014–15 and 11 to 14 percent for grade 12 students in 2015–16. In contrast, over 80 percent of elementary school students participated in the FitnessGram® assessment in 2014–15 and over 73 percent of elementary school students participated in the FitnessGram® assessment in 2015–16.

Table 2.1 presents the number of students per grade level for the 2014–15 and 2015–16 school years.

[14] Austin ISD and Dallas ISD

Table 2.1. – Statewide Number of Students With FitnessGram® Records, 2014–15 and 2015–16

Grade Level	2014–15 Number and Percent of Students with FitnessGram® Results in Sample		2015–16 Number and Percent of Students with FitnessGram® Results in Sample	
	Males	Females	Males	Females
Grade 3	165,665 (81.5%)	158,418 (82.1%)	154,586 (73.5%)	147,710 (74.2%)
Grade 4	165,777 (82.6%)	158,253 (83.3%)	149,892 (73.7%)	143,568 (74.2%)
Grade 5	162,553 (81.8%)	156,263 (82.4%)	147,878 (73.1%)	141,041 (73.5%)
Grade 6	145,868 (74.3%)	141,161 (75.4%)	130,206 (65.2%)	127,485 (66.9%)
Grade 7	131,558 (66.9%)	128,053 (68.8%)	112,887 (56.5%)	110,400 (58.2%)
Grade 8	110,092 (55.3%)	95,725 (50.5%)	88,554 (44.6%)	76,683 (40.8%)
Grade 9	101,714 (46.4%)	89,680 (44.6%)	81,578 (36.5%)	73,609 (35.9%)
Grade 10	63,416 (33.2%)	52,935 (29.0%)	49,495 (25.0%)	41,503 (22.0%)
Grade 11	45,940 (26.4%)	35,680 (21.2%)	38,836 (20.1%)	27,783 (15.9%)
Grade 12	30,613 (19.4%)	23,636 (15.1%)	22,732 (13.9%)	17,275 (10.8%)

Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

The evaluation team also closely examined the demographic characteristics of the student populations with FitnessGram® records in 2014–15 and 2015–16 to ensure that the populations would allow for cross-year comparisons. The analysis revealed that the 2014–15 and 2015–16 student populations were nearly identical (even though the roster of schools submitting FitnessGram® records in each year changed). Table 2.2 shows the percentage of students by gender, economically disadvantaged status, special education status, English language learner status, and race/ethnicity. In addition, the proportions for each year very closely resembles the statewide student population.

Table 2.2. – Statewide Percent of Students in 2014–15 and 2015–16 Samples by Demographic Characteristics

Category	2014–15 Percent of Students	2015–16 Percent of Students
Gender		
Female	48.1%	48.2%
Male	51.9%	51.8%
Economically Disadvantaged	56.7%	56.6%
Special Education	8.4%	8.5%
Limited English Proficient	16.6%	16.5%
Race/Ethnicity		
Asian/Pacific Islander	4.0%	4.1%
Black	11.9%	11.5%
Hispanic	51.7%	51.7%
American Indian/Alaskan Native	0.4%	0.4%
White	30.0%	30.1%
Two or More Races	2.0%	2.1%

Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Descriptive Analysis of FitnessGram® Measures

The percentage of students who were tested and met the threshold for being in the HFZ for each of the following FitnessGram® metrics are reported on a statewide basis as well as disaggregated by gender and school level (i.e., elementary school, middle school, and high school):

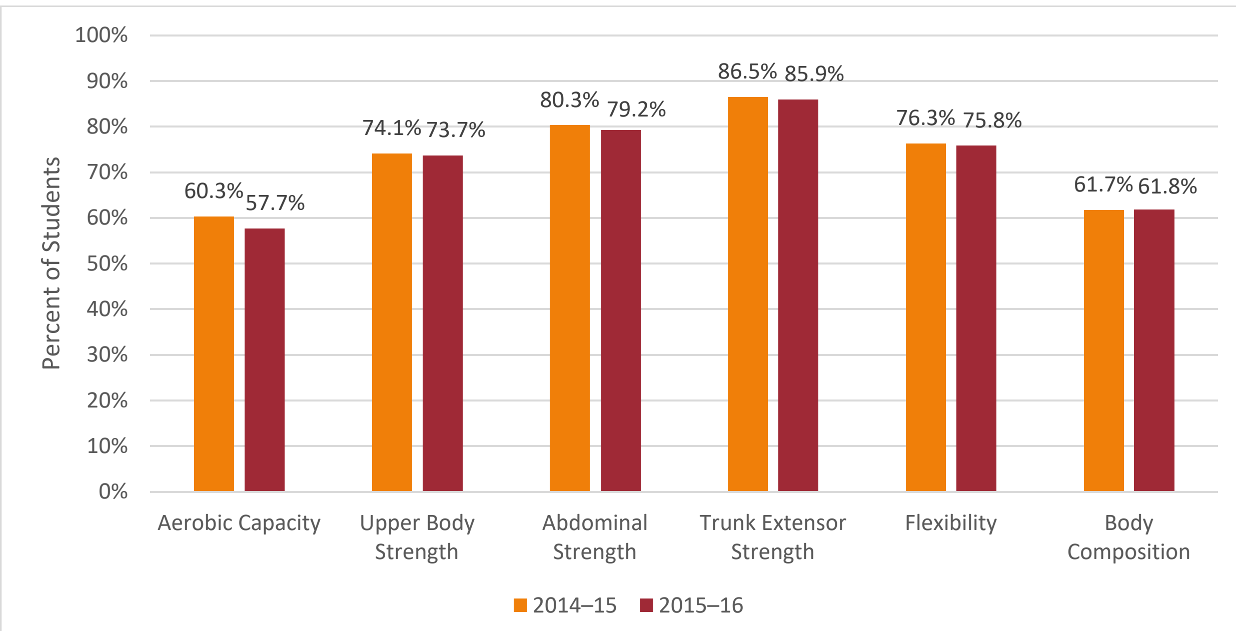
1. Aerobic Capacity
2. Upper Body Muscular Strength and Endurance (Upper Body Strength)
3. Abdominal Muscular Strength and Endurance (Abdominal Strength)
4. Trunk Extensor Muscular Strength and Endurance (Trunk Extensor Strength)
5. Flexibility
6. Body Composition

Statewide Aggregate Results

The vast majority of students (86.5 percent in 2014–15 and 85.9 percent in 2015–16) met the HFZ threshold for Trunk Extensor Strength. Similarly, 8 out of 10 students tested across the state of Texas met the HFZ threshold for the Abdominal Strength and Endurance (80.3 percent in 2014–15 and 79.2 percent in 2015–16), Flexibility (76.3 percent in 2014–15 and 75.8 percent in 2015–16), and Upper Body Strength and Endurance (74.1 percent in 2014–15 and 73.7 percent in 2015–16).

The two FitnessGram® metrics where lower percentages of students were in the HFZ are Aerobic Capacity (60.3 percent in 2014–15 and 57.7 percent in 2015–16) and Body Composition (61.7 percent in 2014–15 and 61.8 percent in 2015–16). The largest drop in the percent of students meeting the HFZ threshold was in the Aerobic Capacity category (-2.6 percentage points), where 60.3 percent of students were in the HFZ in 2014–15 and 57.7 percent of students met the HFZ threshold in 2015–16.

Figure 2.1. – Percent of Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators Overall, 2014–15 and 2015–16



Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: A total of 4,930,639 male students were included in the 2014–15 analysis, while 5,400,954 male students were included in the 2015–16 analysis. A total of 5,567,975 female students were included in the 2014–15 analysis, while 5,026,147 female students were included in the 2015–16 analysis.

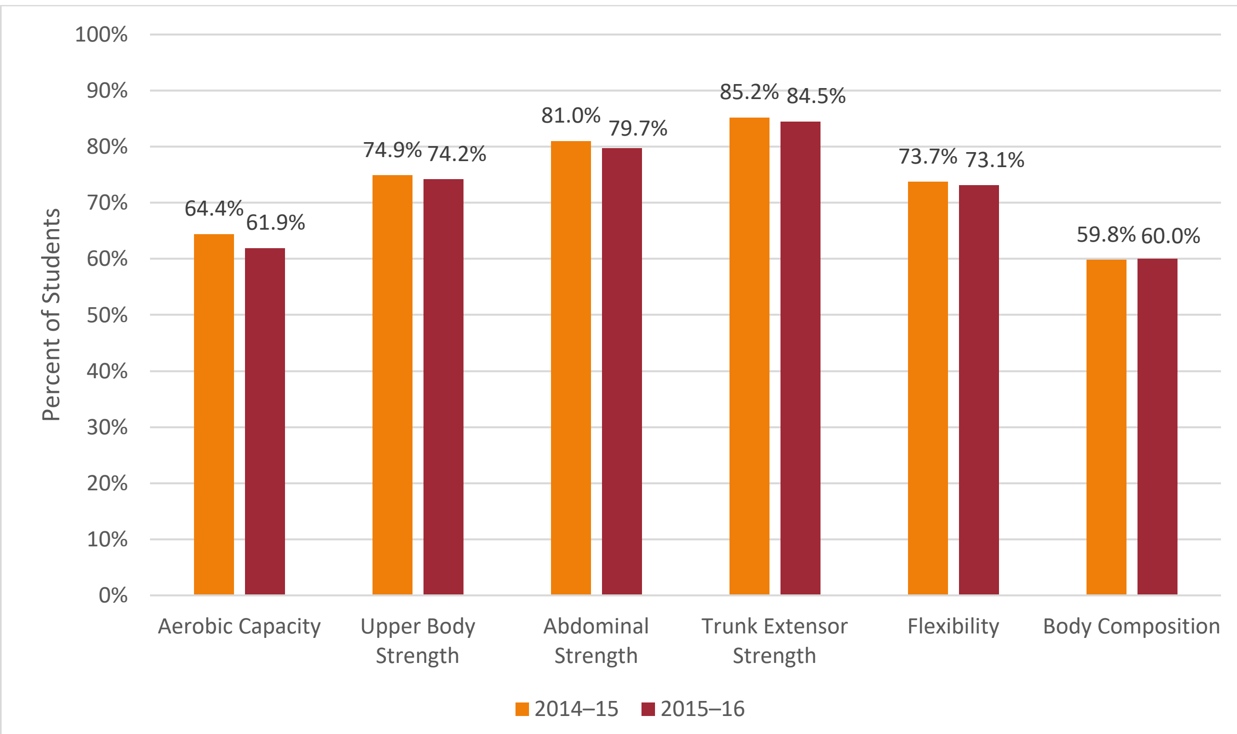
Results Disaggregated by Gender

As Figures 2.2 and 2.3 illustrate, a larger proportion of male students were in the HFZ for Aerobic Capacity (64.4 percent in 2014–15 and 61.9 percent in 2015–16) compared to female students (55.9 percent in 2014–15 and 53.3 percent in 2015–16). However for both male and female students, the proportion of students meeting the HFZ threshold for Aerobic Capacity was approximately 2.5 percentage points lower in 2015–16 than it was in 2014–15.

Male students were also in the HFZ slightly more frequently than female students for Upper Body Strength and Abdominal Strength. In contrast, female students were in the HFZ for Body Composition, Trunk Extensor Strength, and Flexibility more often than male students in both 2014–15 and 2015–16.

For both male and female students, the largest difference between 2014–15 and 2015–16 in the proportion of students meeting the HFZ threshold, was observed in the Aerobic Capacity fitness metric. The percentage of male students in the HFZ for Aerobic Capacity dropped by 2.5 percentage points between 2014–15 and 2015–16 and by 2.6 percentage points for female students (Figures 2.2 and 2.3).

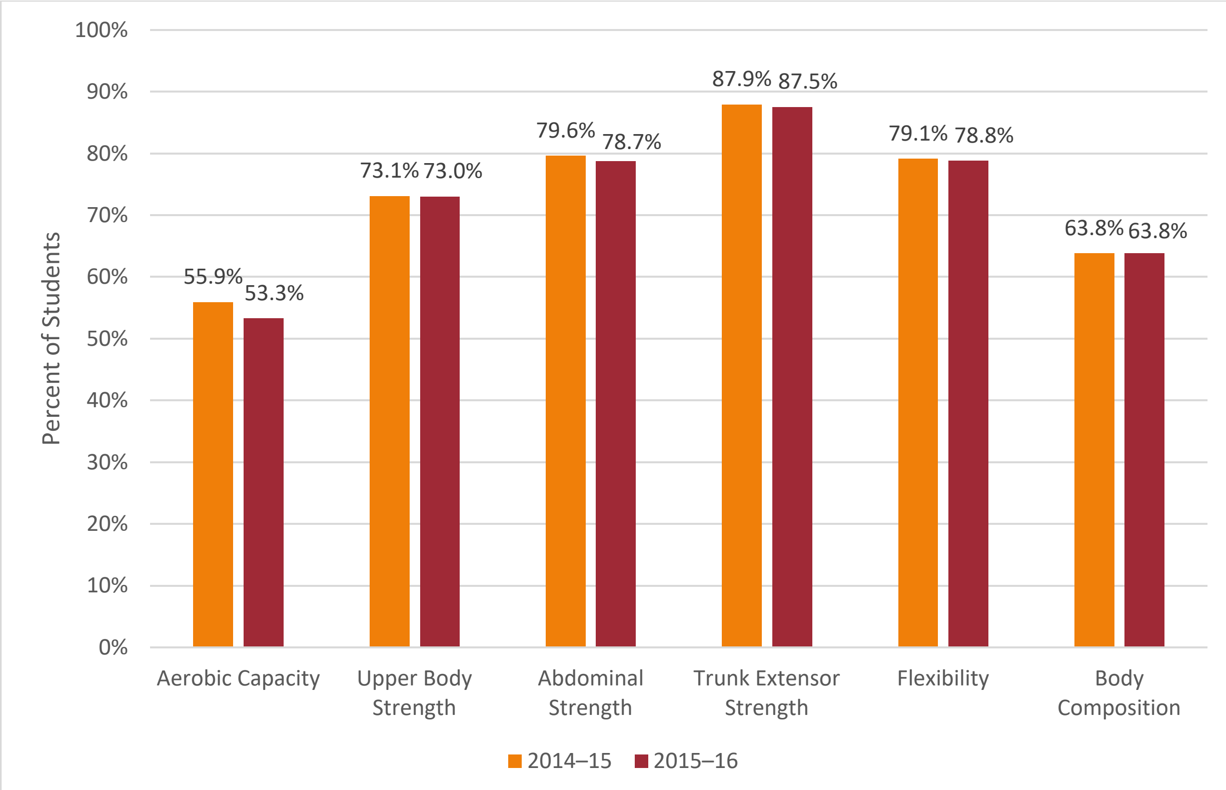
Figure 2.2. – Percent of Male Students Meeting Healthy Fitness Zone Thresholds for the Six FitnessGram® Indicators, 2014–15 and 2015–16



Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: For 2014–15 and 2015–16 data respectively, 568,273 and 797,000 male students were included for the Aerobic Capacity HFZ; 1,098,201 and 913,240 male students were included for the Upper Body Strength HFZ; 1,100,108 and 939,005 male students were included for the Abdominal Strength HFZ; 1,068,574 and 903,923 male students were included for the Trunk Extensor Strength HFZ; 1,084,415 and 938,337 male students were included for the Flexibility HFZ; and 1,079,642 and 909,449 male students were included for the Body Composition HFZ.

Figure 2.3. – Percent of Female Students Meeting Healthy Fitness Zone Thresholds for the Six FitnessGram® Indicators, 2014–15 and 2015–16



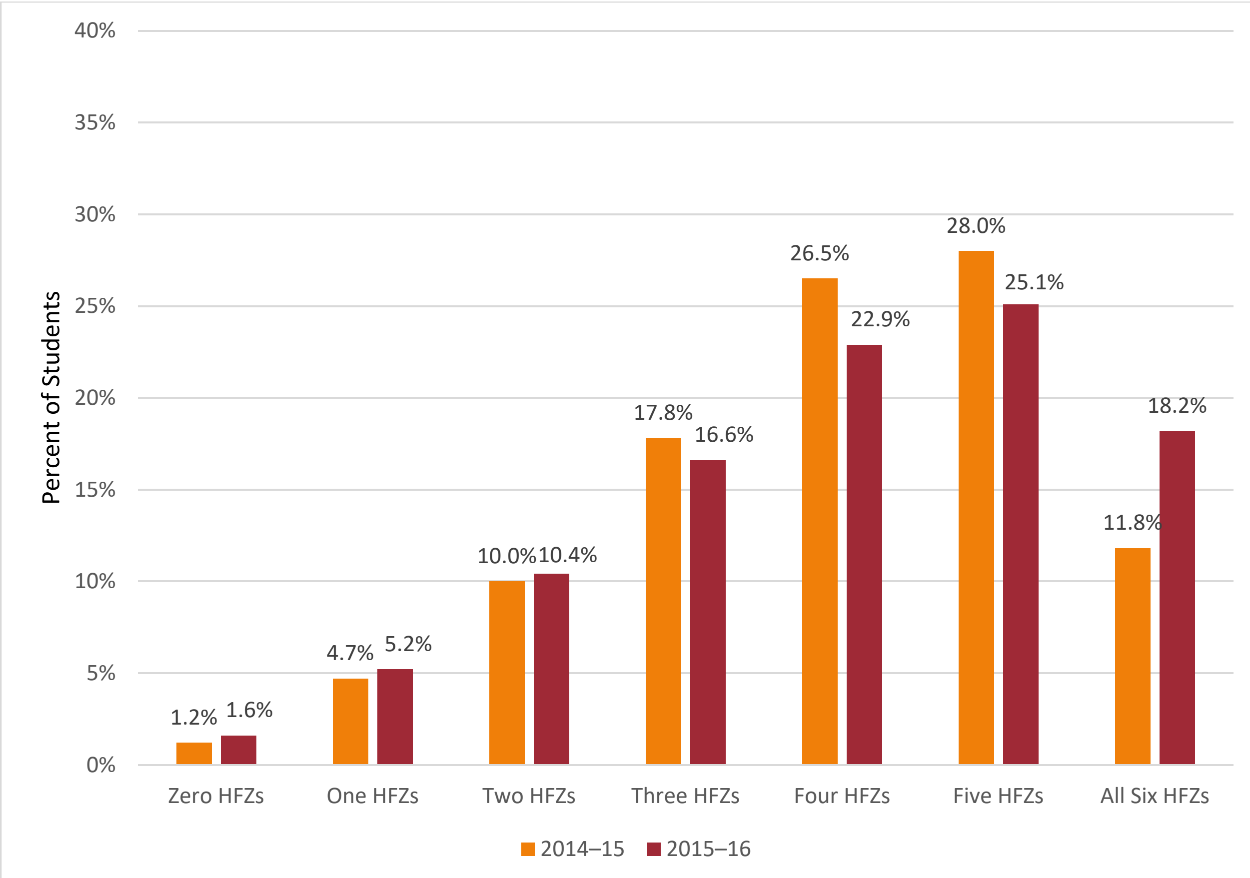
Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: For 2014–15 and 2015–16 data respectively, 528,510 and 734,381 female students were included for the Aerobic Capacity HFZ; 1,017,668 and 851,103 female students were included for the Upper Body Strength HFZ; 1,018,774 and 874,385 female students were included for the Abdominal Strength HFZ; 993,567 and 844,716 female students were included for the Trunk Extensor Strength HFZ; 1,007,175 and 874,757 female students were included for the Flexibility HFZ; and 1,002,281 and 846,805 female students were included for the Body Composition HFZ.

On average, students across the state of Texas met the HFZ threshold on four of the six FitnessGram® categories in both 2014–15 and 2015–16. Figure 2.4 illustrates the percentage of male students who met the HFZ threshold for zero metrics, one metric, two metrics, three metrics, four metrics, five metrics, and for all 6 FitnessGram® metrics.

Approximately two-thirds of all tested male students in 2014–15 (66.3 percent) and 2015–16 (66.2 percent) achieved HFZ status in at least four of the six metrics; however, a larger proportion of male students achieved HFZ status on all six FitnessGram® metrics in 2015–16 (18.2 percent) than did in 2014–15 (11.8 percent). Less than two percent of male students across the state failed to meet HFZ thresholds for any of the six metrics.

Figure 2.4. – Percent of Male Students Meeting Healthy Fitness Zone Thresholds by Number of FitnessGram® Indicators, 2014–15 and 2015–16



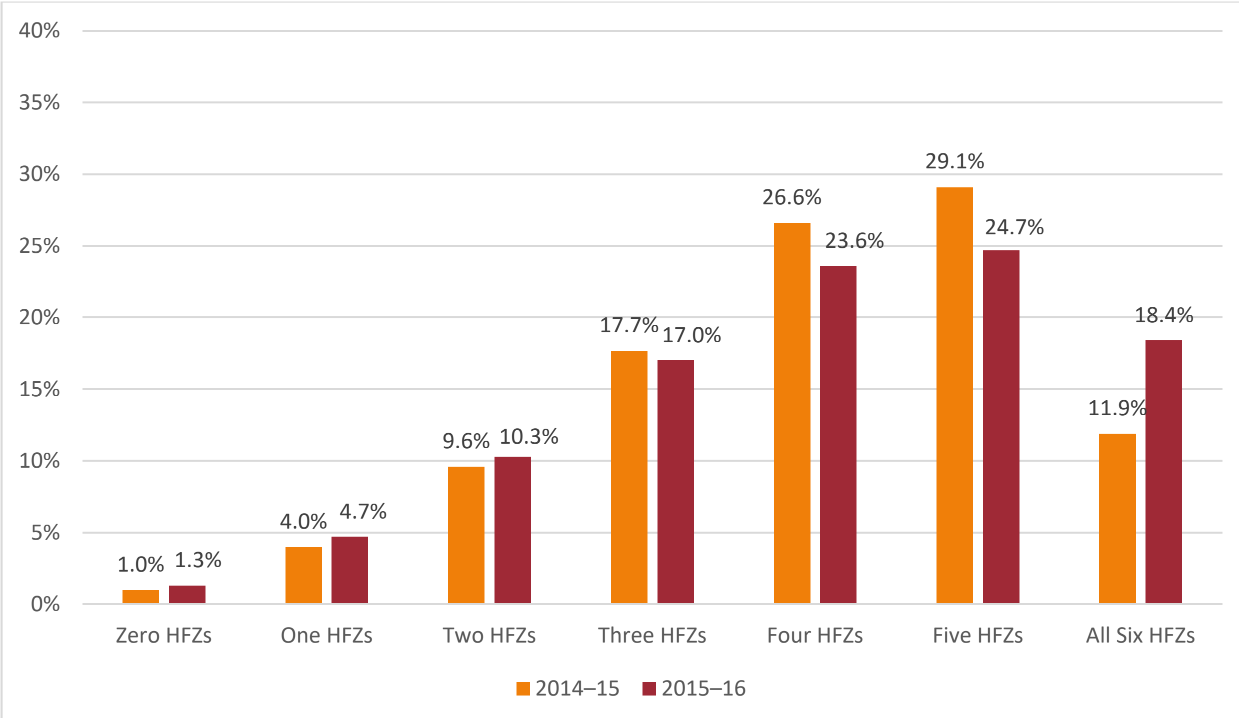
Source: FitnessGram® data, 2014–15 and 2015–16, Texas Education Agency data, 2014–15 and 2015–16.

Note: For 2014–15 and 2015–16 data respectively, 568.273 and 797,000 male students were included for the Aerobic Capacity HFZ; 1,098,201 and 913,240 male students were included for the Upper Body Strength HFZ; 1,100,108 and 939,005 male students were included for the Abdominal Strength HFZ; 1,068,574 and 903,923 male students were included for the Trunk Extensor Strength HFZ; 1,084.415 and 938,337 male students were included for the Flexibility HFZ; and 1,079,642 and 909,449 male students were included for the Body Composition HFZ.

Figure 2.5 illustrates the percentage of female students who met the HFZ threshold for zero metrics, one metric, two metrics, three metrics, four metrics, five metrics, and for all six FitnessGram® metrics.

Similar to male students, a larger proportion of female students achieved HFZ status on all FitnessGram® metrics in 2015–16 than did in 2014–15 (18.4 percent compared to 11.9 percent). As with male students, less than two percent of female students fail to meet HFZ thresholds for any of the metrics.

Figure 2.5. – Percent of Female Students Meeting Healthy Fitness Zone Thresholds by Number of FitnessGram® Indicators, 2014–15 and 2015–16



Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: For 2014–15 and 2015–16 data respectively, 528,510 and 734,381 female students were included for the Aerobic Capacity HFZ; 1,017,668 and 851,103 female students were included for the Upper Body Strength HFZ; 1,018,774 and 874,385 female students were included for the Abdominal Strength HFZ; 993,567 and 844,716 female students were included for the Trunk Extensor Strength HFZ; 1,007,175 and 874,757 female students were included for the Flexibility HFZ; and 1,002,281 and 846,805 female students were included for the Body Composition HFZ.

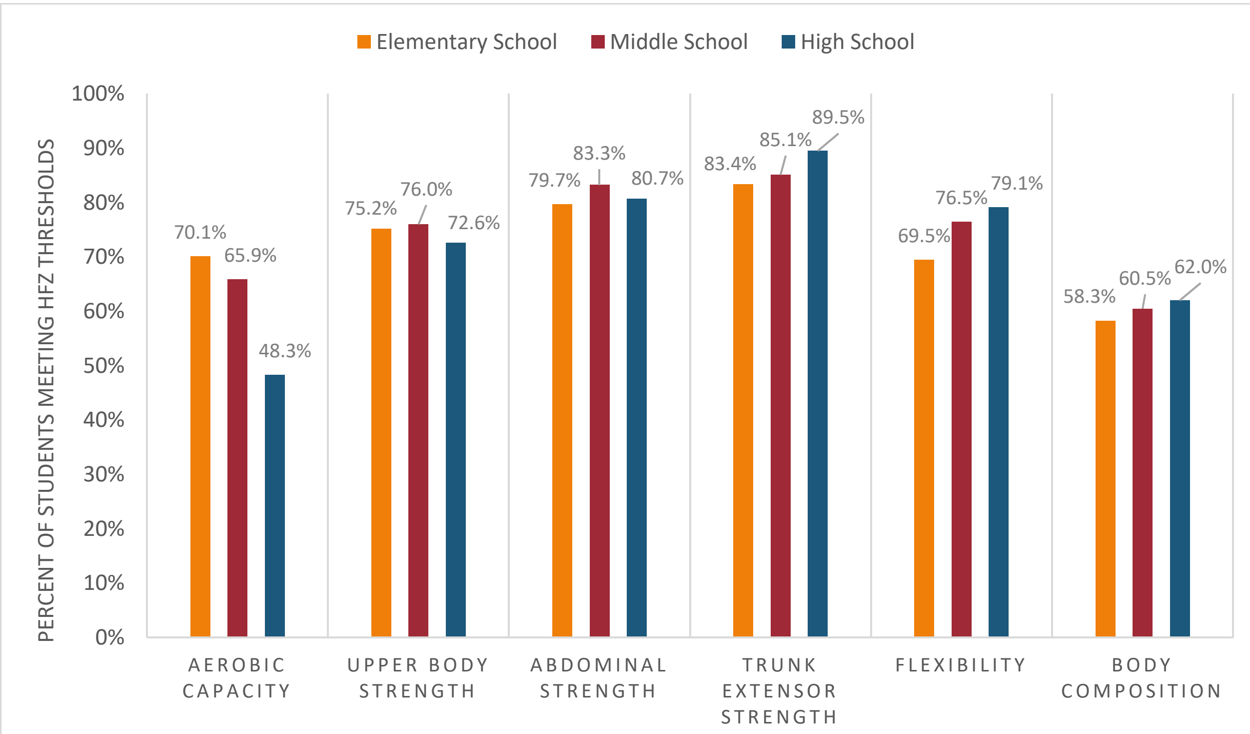
Results Disaggregated by School Level for Male and Female Students

As Figures 2.6 and 2.7 illustrate, the percentage of male students meeting the HFZ threshold for Aerobic Capacity was lower for high school students (48.3 percent on 2014–15 and 49.5 percent in 2015–16) than for elementary or middle school students (which ranges from 64.7 percent to 70.1 percent over the two years). It is also important to note that a smaller proportion of high school students were tested on FitnessGram® metrics than elementary and middle schools students. Because of participation in athletics and other extracurricular activities, it is possible that the population of tested high school students may be different in meaningful ways from non-tested students which may impact the results. Since students can satisfy their physical education requirement with other course options, it may be that students who are more likely to take physical education courses in which they are assessed with FitnessGram® have different fitness profiles from students who satisfy this requirement with athletics or extracurricular activities.

For two metrics, Trunk Extensor Strength and Flexibility, a larger proportion of male high school students (89.5 to 89.8 percent for Trunk Extensor Strength and 79.1 to 78.5 percent for Flexibility for 2014–15 and 2015–16, respectively) were in the HFZ than their elementary and middle school counterparts.

For several of the other FitnessGram® metrics, such as Upper Body Strength, Abdominal Strength, and Body Composition, little difference in the percentage of students in the HFZ was observed across male students in elementary, middle, and high school.

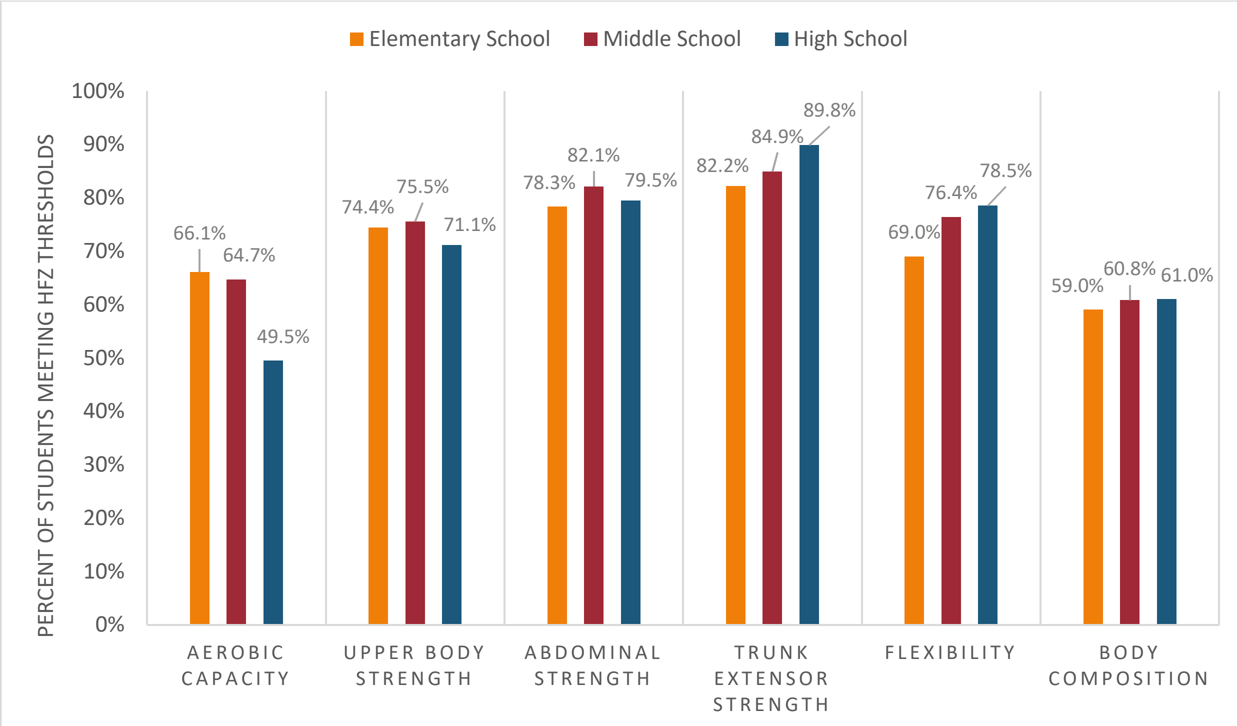
Figure 2.6. – Percent of Male Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators by School Level, 2014–15



Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2014–15, Texas Education Agency.

Note: A total of 243,925 elementary school, 194,294 middle school, and 101,515 high school students were included in the Aerobic Capacity HFZ; a total of 502,017 elementary school, 309,293 middle school, and 223,518 high school students were included in the Upper Body Strength HFZ; a total of 503,558 elementary school, 310,330 middle school, and 223,524 high school students were included in the Abdominal Strength HFZ; a total of 494,115 elementary school, 300,506 middle school, and 215,182 high school students were included in the Trunk Extensor Strength HFZ; a total of 500,787 elementary school, 306,378 middle school, and 216,654 high school students were included in the Flexibility HFZ; and a total of 493,547 elementary school, 304,440 middle school, and 219,203 high school students were included in the Body Composition HFZ.

Figure 2.7. – Percent of Male Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators by School Level, 2015–16

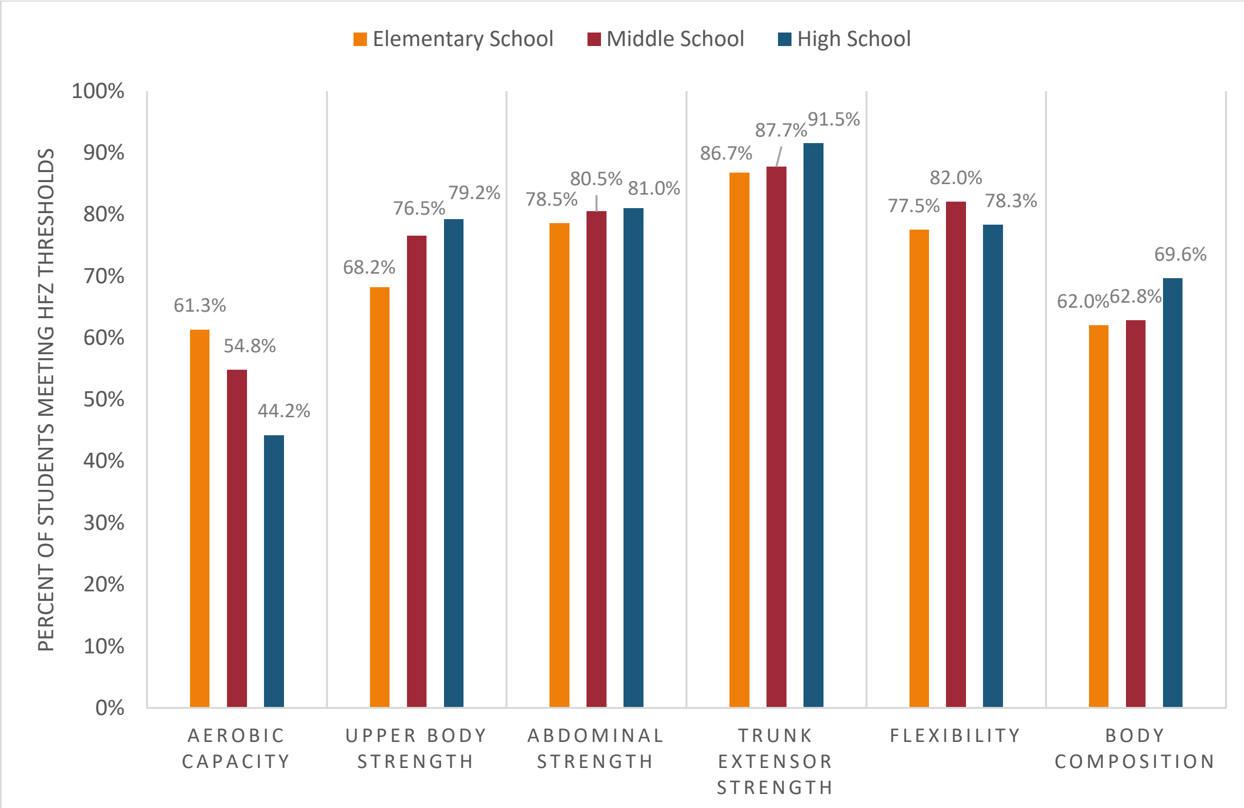


Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2015–16, Texas Education Agency.

Note: A total of 316,215 elementary school, 255,999 middle school, and 168,379 high school students were included in the Aerobic Capacity HFZ; a total of 442,031 elementary school, 249,536 middle school, and 162,743 high school students were included in the Upper Body Strength HFZ; a total of 452,022 elementary school, 258,285 middle school, and 168,730 high school students were included in the Abdominal Strength HFZ; a total of 436,776 elementary school, 250,271 middle school, and 161,486 high school students were included in the Trunk Extensor Strength HFZ; a total of 449,935 elementary school, 257,551 middle school, and 169,598 high school students were included in the Flexibility HFZ; and a total of 434,333 elementary school, 248,957 middle school, and 167,695 high school students were included in the Body Composition HFZ.

The school level results for female students mirror those reported for male students with Aerobic Capacity; results were lower (over 10 percentage points) for high school students than for elementary and middle school female students. In 2014–15, a significantly smaller proportion of female students in middle school (62.8 percent) met the Body Composition HFZ threshold compared to high school students (69.6 percent). Figures 2.8 and 2.9 present complete results for each of the six measures for 2014–15 and 2015–16, respectively.

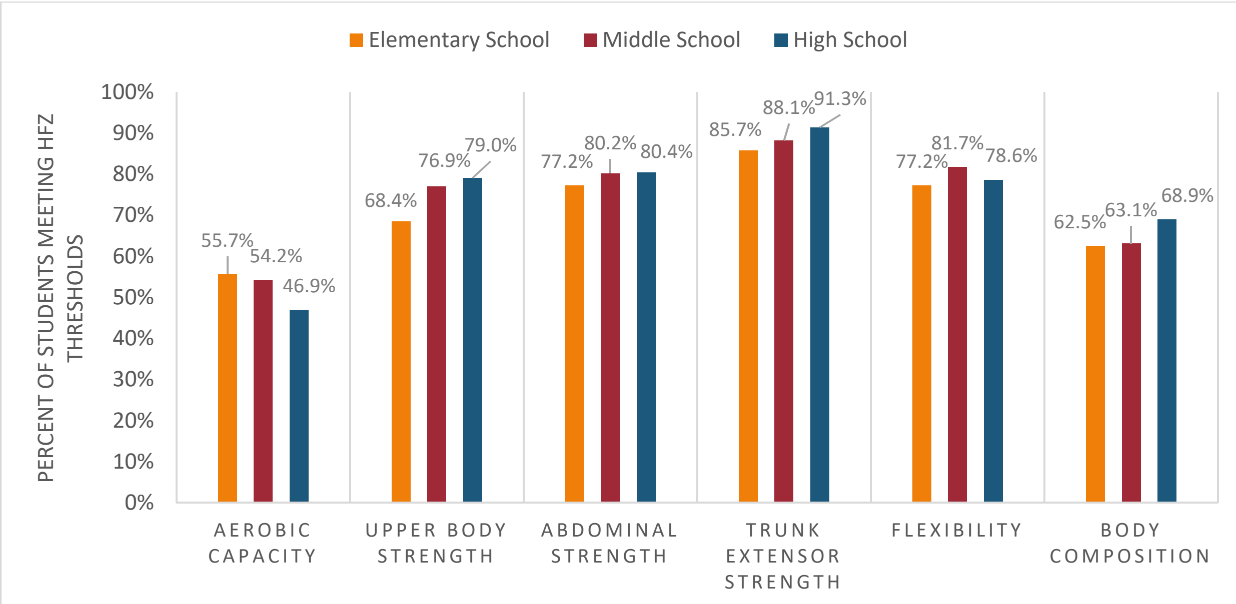
Figure 2.8. – Percent of Female Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators by School Level, 2014–15



Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2014–15, Texas Education Agency.

Note: A total of 231,528 elementary school, 181,190 middle school, and 86,007 high school students were included in the Aerobic Capacity HFZ; a total of 480,714 elementary school, 286,567 middle school, and 186,157 high school students were included in the Upper Body Strength HFZ; a total of 482,206 elementary school, 287,512 middle school, and 185,652 high school students were included in the Abdominal Strength HFZ; a total of 473,131 elementary school, 280,631 middle school, and 180,037 high school students were included in the Trunk Extensor Strength HFZ; a total of 479,556 elementary school, 285,743 middle school, and 180,210 high school students were included in the Flexibility HFZ; and a total of 463,336 elementary school, 282,529 middle school, and 182,698 high school students were included in the Body Composition HFZ.

Figure 2.9. – Percent of Female Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators by School Level, 2015–16



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2015–16, Texas Education Agency.

Note: A total of 298,244 elementary school, 240,330 middle school, and 140,937 high school students were included in the Aerobic Capacity HFZ; a total of 422,269 elementary school, 234,842 middle school, and 136,364 high school students were included in the Upper Body Strength HFZ; a total of 432,059 elementary school, 241,660 middle school, and 142,173 high school students were included in the Abdominal Strength HFZ; a total of 417,911 elementary school, 235,379 middle school, and 136,582 high school students were included in the Trunk Extensor Strength HFZ; a total of 430,004 elementary school, 241,746 middle school, and 143,042 high school students were included in the Flexibility HFZ; and a total of 415,226 elementary school, 234,654 middle school, and 140,089 high school students were included in the Body Composition HFZ.

Bivariate Correlational Relationship Between Physical Fitness Metrics and Academic Outcomes

Gibson conducted a bivariate correlation analysis (which assesses the relationship between two variables of interest) to test each relationship outlined in the research questions. More specifically, the relationship between a student being in the HFZ for each of the six FitnessGram® metrics and student academic (e.g., percentile rank in STAAR reading and mathematics scores and EOC Algebra I and English I scores for Grade 9) and non-academic (e.g., regular school day attendance rate and the number of in-school and out-of-school suspensions) measures. Throughout this discussion we reference both the direction of the correlation and the strength or magnitude of the correlation.[15] Tests of statistical significance for correlations assess whether a correlation that is statistically different from zero was observed.[16]

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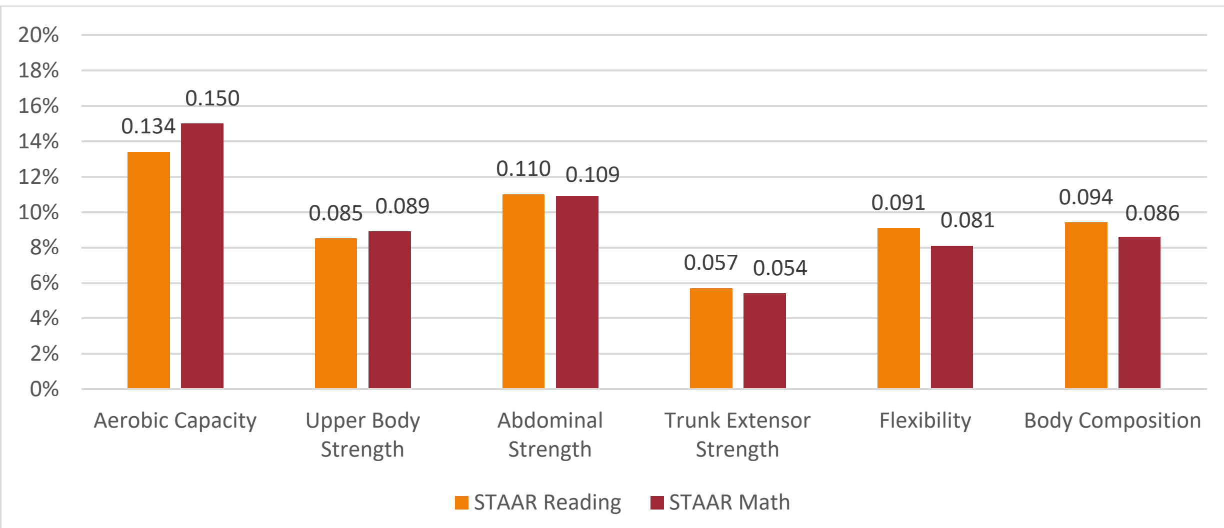
[15] Correlations below .40 are considered to be weak, correlations in the .40 to .69 range are considered to be moderate, and correlations above .70 are considered to be strong (Hinkle, Wiersm, & Jurs, 2003).

[16] See footnote 2.

Research Question 2.1: Is There a Relationship Between HFZ Attainment and STAAR Performance?

To investigate the relationship between test performance and FitnessGram® outcomes, we used a standardized measure (percentile rank) based on the mathematics and reading STAAR exam scores. This percentile rank was calculated for each student included in the analyses and is used as the outcome measure of interest for academic performance.[17] As Figure 2.10 shows, for 2014–15, the strongest correlations between a FitnessGram® HFZ measure and percentile ranking on the STAAR reading and mathematics exams was observed for the Aerobic Capacity measure, with Spearman correlation coefficients of 0.13 with STAAR reading and 0.15 for STAAR mathematics. Abdominal Strength had the second highest level of correlation with STAAR academic outcomes with correlations of .11 for STAAR reading and mathematics. While all of the correlations described in Figure 2.10 are statistically significant, they are considered weak relationships.

Figure 2.10. – Correlational Results Between FitnessGram® HFZ Metrics and STAAR Reading and Mathematics Results, 2014–15



Source: FitnessGram® data, 2014–15; Texas Education Agency data, 2014–15; Public Education Information Management System, 2014–15, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15; Texas Education Agency.

Note: There were 1,183 districts and 7,747 campuses included in the 2014–15 analysis.

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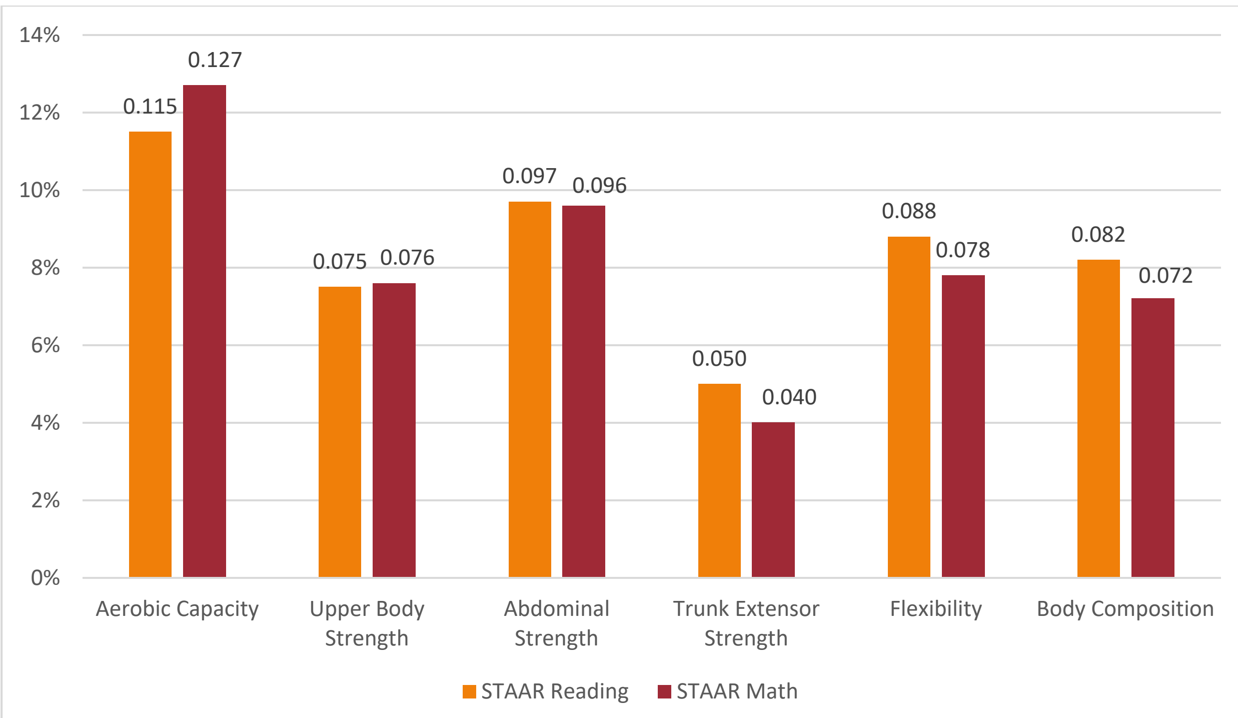
[17] STAAR tests, whether mathematics or reading, are reported using scale scores (which are linked to standards set by the State). The scale scores are not comparable between grade levels, academic years, or test subjects. In order to compare students' scores across grades, the evaluation team standardized the scale scores within each test subject, at each grade level, and for each year in order to make these scores comparable. The percentile rank score indicates the percentage of students that scored at or below that score for each test. So, a student scoring in the 90^{th} percentile scored better than 90% of the students who took that test.

While the 2015–16 correlational results were similar to those described for 2014–15, the strength of the relationship between each of the FitnessGram® HFZ categories was stronger in 2014–15 than 2015–16. For 2015–16, similar to the prior year, the strongest correlations between a FitnessGram® HFZ measure and the percentile ranking on the STAAR reading and mathematics exams was observed for the Aerobic Capacity (Spearman correlation coefficients of 0.12 with STAAR reading and 0.13 for STAAR mathematics) and the Abdominal Strength (Spearman correlation coefficients of 0.10 for both STAAR reading and STAAR mathematics). Like the 2014–15 results, all of the correlations shown in Figure 2.11 are statistically significant but weak in strength (Figure 2.11)

Figure 2.11. – Correlational Results Between FitnessGram® HFZ Metrics and STAAR Reading and Mathematics Results, 2015–16



Source: FitnessGram® data 2015–16, Texas Education Agency data, 2015–16; Public Education Information Management System, 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2015–16, Texas Education Agency.

Note: There were 1,181 districts and 7,787 campuses included in the 2015–16 analysis.

The evaluation team also explored the relationship between two additional fitness metrics, body fat percentile and BMI percentile, and student academic performance on the STAAR exams. As Table 2.3 shows, the strongest relationship observed was between BMI percentile and STAAR reading and mathematics percentile rank in 2014–15. The Spearman correlation coefficient revealed a weak statistical relationship between the two additional fitness variables (the Spearman correlation coefficient was -0.11 for both mathematics and reading).

Table 2.3. – Correlational Results Between Obesity-Related Metrics and STAAR Reading and Mathematics Results, 2014–15 and 2015–16

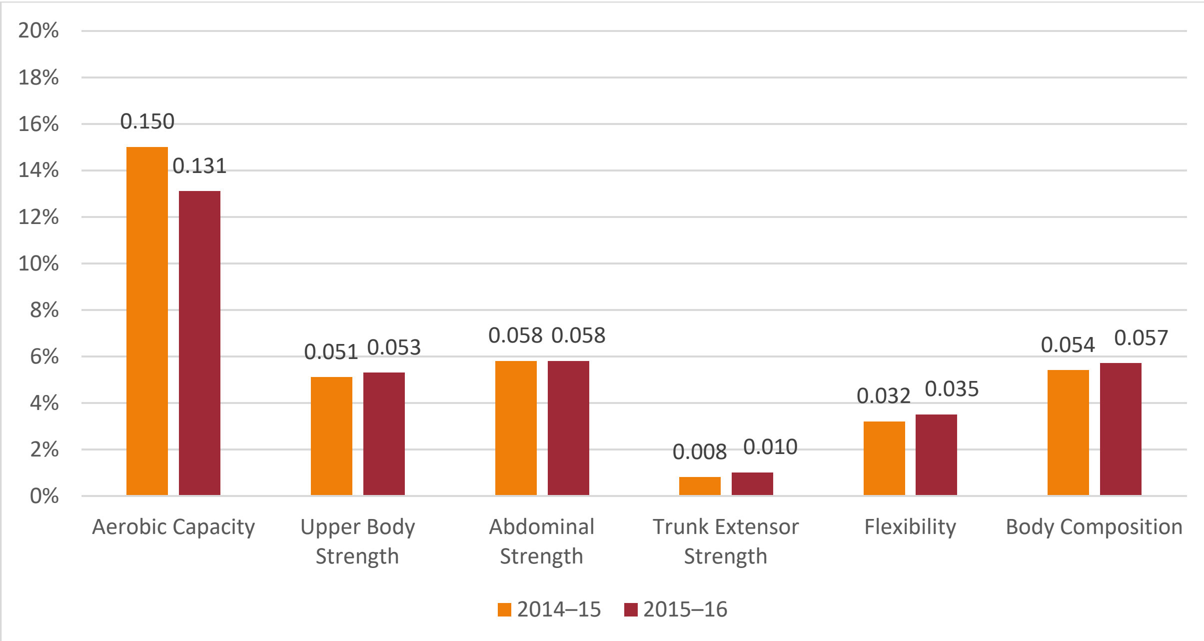
Fitness Metric	2014–15 STAAR reading	2014–15 STAAR mathematics	2015–16 STAAR reading	2015–16 STAAR mathematics
Body Fat Percentile	-0.06	-0.06	-0.04	-0.06
BMI Percentile	-0.11	-0.11	-0.09	-0.09

Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Research Question 2.2: Is There a Relationship Between HFZ Attainment and Student Attendance?

The TEA defines attendance rate as the percentage of eligible days students were present in a given school year, based on student enrollment for the entire school year. Student attendance rates are calculated by taking the total number of days a student was present and dividing by the total number of days a student was in membership at the school. Similar to the results for academic outcomes, the relationship between FitnessGram® HFZ measures and school attendance was weak, but strongest for the Aerobic Capacity metric (Spearman correlation coefficient of 0.15 in 2014–15 and 0.13 in 2015–16) (Figure 2.12).

Figure 2.12. – Correlational Results Between FitnessGram® HFZ Metrics and Student Attendance Rate, 2014–15 and 2015–16



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: There were 1,183 districts and 7,747 campuses included in the 2014–15 analysis, with 1,181 districts and 7,787 campuses in the 2015–16 analysis.

A weak, though statistically significant negative relationship was observed between body fat percentile and BMI percentile and student attendance rates in both 2014–15 and 2015–16. That is, as body fat percentile and BMI percentile increase, student attendance rates decline. The strongest relationship was observed between BMI percentile and attendance (Spearman correlation coefficient of -0.07 for both 2014–15 and 2015–16) (Table 2.4).

Table 2.4. – Correlational Results Between FitnessGram® HFZ Metrics and Body Composition Metrics, 2014–15 and 2015–16

Fitness Metric	2014–15 Student Attendance	2015–16 Student Attendance
Body Fat Percentile	-0.07	-0.05
BMI Percentile	-0.07	-0.07

Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Research Question 2.3: Is There a Relationship Between HFZ Attainment and Student Obesity?

FitnessGram® data include BMI and the percentage body fat, either of which can be used to classify a student as being in the HFZ. BMI is recognized by the Centers for Disease Control and Prevention as a measure of childhood obesity. For children, BMI is used to screen for being obese, overweight, at a healthy weight, or underweight.

Table 2.5. – BMI Classifications for Children[18]

Category	BMI
Underweight	Less than the 5th percentile
Normal weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obesity	95th percentile or greater

Source: Centers for Disease Control and Prevention, 2017.

BMI is calculated by multiplying the child's weight in pounds by 703 and dividing by the square of the child's composite height in inches. The BMI number is then scaled to a percentile by age and gender, which is used to classify children into categories (FitnessGram® also uses age and gender specific cut points for classification). The National Institutes of Health BMI categories are listed in Table 2.5. The evaluation team used age-and-gender-standardized percentage body fat and BMI, and whether the student is in the Body Composition HFZ to analyze the relationship with the other fitness measures.

As expected, a negative relationship was observed between most of the FitnessGram® HFZ metrics and BMI percentile. That is, when BMI percentile increased, the likelihood of meeting HFZ thresholds declined. As was found in other correlational analyses presented in this chapter, Aerobic Capacity was more strongly associated with BMI percentile rank than the other FitnessGram® measures. The correlation level between Aerobic Capacity and BMI percentile was -0.32 in 2014–15 and -0.40 in 2015–16, approaching the moderate level of relationship strength. Not surprisingly, the relationship between Body Composition HFZ and BMI Percentile are highly correlated (Spearman correlation coefficient is 0.85 for 2014–15 and 0.86 in 2015–16). This means that when the percentile rank in BMI goes up (i.e., the student has a higher BMI), the likelihood of the student achieving Body Composition HFZ is lower (Table 2.6).

[18] From the Centers for Disease Control, https://www.cdc.gov/obesity/childhood/defining.html, Accessed on 3/7/2017

Upper Body Strength HFZ was negatively correlated with BMI percentile as well, with a correlation level of -0.22 in 2014–15 and in 2015–16. The correlations between the other FitnessGram® HFZ measures and BMI percentage were weak (each smaller than +/-0.20) (Table 2.6).

Table 2.6. – Correlational Results Between FitnessGram® HFZ Netrics and BMI Percentile, 2014–15 and 2015–16

Fitness Metric	2014–15 BMI Percentile	2014–15 BMI Percentile
Aerobic Capacity	-0.32	-0.40
Body Composition	-0.85	-0.86
Upper Body Strength	-0.22	-0.22
Abdominal Strength	-0.17	-0.17
Trunk Extensor Strength	0.02	0.02
Flexibility	-0.16	-0.16

Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Research Question 2.4: Is There a Relationship Between HFZ Attainment and Student Disciplinary Problems?

Regarding disciplinary removals, administrators can choose from a formal range of options outlined in the code of conduct. School districts report four of those to TEA: in-school suspensions (ISS), out-of-school suspensions (OSS), disciplinary alternative education programs (DAEP), and juvenile justice alternative education programs (JJAEP) (or expulsion where not available).

To understand how discipline actions and HFZ are associated, the research team used each of the four sanctions and the types and numbers of discipline incidents (i.e., whether the actions were a result of mandatory or discretionary incidents) recorded in PEIMS as variables for conducting similar analyses to those described for student academic achievement in order to examine whether statistically significant associations exist between student discipline involvement and HFZ attainment. Gibson generated counts of each type of disciplinary action (ISS and OSS) and used the to determine whether there is a relationship between disciplinary actions and fitness measures.

As Table 2.7 shows, the relationship between physical fitness metrics and the number of ISS and OSS referrals a student received is very weak. For the ISS referral outcome measure, correlation coefficients for the six FitnessGram® HFZ measures ranges from -0.02 to -0.08 in 2014–15 and from -0.01 to -0.06 in 2015–16. In both years, Aerobic Capacity HFZ had the strongest relationship to ISS referrals but the strength of the correlation is still quite weak when considering 0.40 as the threshold for moderate strength. Similarly, for the more serious OSS referrals, correlation coefficients for the six FitnessGram® HFZ measures ranged from -.01 to -.07 in 2014–15 and from -.01 to -.06 in 2015–16, with the strongest correlation between

Aerobic Capacity and OSS referrals. In both years the relationship for each HFZ measure is directionally what physical education programs would hope for (i.e., increase in students achieving HFZ status related to decreases in ISS and OSS referrals), but also weaker in magnitude than any of the academic and student attendance measures described in this chapter.[19]

The relationship between Body Fat Percentile and BMI Percentile and disciplinary referrals was also extremely weak with correlation coefficients never exceeding .04 across the two years of data included in this analysis (Table 2.7).

Table 2.7. – Correlational Results Between Physical Fitness Metrics and ISS and OSS Disciplinary Referrals, 2014–15 and 2015–16

Fitness Metric	2014–15 Number of ISS Referrals	2015–16 Number of ISS Referrals	2014–15 Number of OSS Referrals	2015–16 Number of OSS Referrals
Aerobic Capacity HFZ	-0.08	-0.06	-0.07	-0.06
Body Composition HFZ	-0.02	-0.02	-0.01	-0.02
Upper Body Strength HFZ	-0.02	-0.02	-0.02	-0.02
Abdominal Strength HFZ	-0.03	-0.03	-0.03	-0.03
Trunk Extensor Strength HFZ	-0.01	-0.01	-0.02	-0.02
Flexibility HFZ	-0.02	-0.02	-0.01	-0.01
Body Fat Percentile	0.02	0.00	0.02	0.01
BMI Percentile	0.04	0.03	0.03	0.03

Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Research Question 2.5: Is There a Relationship Between HFZ Attainment and Student Participation in School Meal Programs?

The administrative records provided to the research team included indicators for whether students qualified for free or reduced priced lunch under the National School Lunch Program (NSLP). Table 2.8 provides data which examines the correlational relationship between key physical fitness metrics and participation in the NSLP program. We have calculated correlation coefficients for two levels of participation in the program: 1) students eligible for free lunch based on their parents' income level; and 2) students eligible for reduced-price lunch based on their parent's income level. This disaggregation allows for further examination of the

[19] The correlational relationship between FitnessGram® HFZ metrics and the number of Disciplinary Alternative Education Program (DAEP) referrals for more serious infractions was also explored. The relationship was even weaker has for ISS and OSS referrals with Spearman Correlation coefficients ranging from -.003 to -.050 in 2014-15 and from -.002 to -.041 in 2015-16

relationship between fitness and student economic disadvantaged status. Here we calculate coorelations separately by each economic disadvantaged status group (e.g., *eligible for free meals* and *eligible for reduced price meals*).

The strength of the correlation between most of the fitness metrics and a student being eligible for free meals (i.e., an indicator of the highest poverty level) was much stronger than the relationship between the fitness metrics and a student being eligible for reduced-price lunch. For instance, the correlation coefficient between BMI percentile and a student being eligible for free meals is 0.11 for 2014–15 and 2015–16; however, the correlation coefficient between BMI percentile and a student being eligible for reduced-price meals is close to zero, indicating no relationship (0.01 for 2014–15 and 2015–16). This implies that the more economically disadvantaged students who are eligible for free meals have higher BMI percentile ranks. However, it is important to note that all of the correlations between the eight fitness metrics in Table 2.8 are weak, typically below .10, but directional as expected (i.e., higher poverty levels related to lower levels of fitness across each metric included in the analysis).

Table 2.8. – Correlational Results Between Physical Fitness Metrics and Free or Reduced Priced Lunch Eligibility, 2014–15 and 2015-16

Fitness Metric	2014–15 Eligible for Free Meals	2015–16 Eligible for Free Meals	2014–15 Eligible for Reduced Price Meals	2015–16 Eligible for Reduced Price Meals
Aerobic Capacity HFZ	-0.078	-0.094	-0.003	-0.006
Body Composition HFZ	-0.098	-0.092	-0.011	-0.009
Upper Body Strength HFZ	-0.058	-0.050	-0.005	-0.002
Abdominal Strength HFZ	-0.074	-0.067	-0.002	-0.002
Trunk Extensor Strength HFZ	-0.035	-0.026	-0.001	0.002
Flexibility HFZ	-0.046	-0.047	-0.003	-0.002
Body Fat Percentile	0.047	0.047	0.010	0.011
BMI Percentile	0.113	0.106	0.011	0.009

Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2014–15, Texas Education Agency.

Summary of Descriptive and Correlational Results

While the strength of the correlations between physical fitness metrics were statistically significant and weak for both 2014–15 and 2015–16 (primarily due to the large number of students included in the analyses), they were directionally consistent with higher levels of physical fitness being associated with better academic outcomes (STAAR reading and STAAR mathematics percentile rankings), school attendance, and disciplinary referrals (ISS and OSS referrals). In addition, percentile rank in BMI (i.e., an indicator of being less fit) was associated with a higher likelihood of being eligible for free meals, but not necessarily reduced-priced meals. Further, the Aerobic Capacity HFZ measure had the strongest relationship with academic and non-academic student outcomes across all metrics in both 2014–15 and 2015–16.

Chapter 3 – Multivariate Relationship Between Physical Fitness Metrics and Student Outcomes

Introduction

Chapter 2 of this report provided descriptive information related to the percentage of students meeting HFZ thresholds for the six FitnessGram® measures, and an examination of bivariate correlations regarding the strength of the relationship between FitnessGram® HFZ metrics and various student outcomes. While descriptive analyses bivariate correlations can be informative, multivariate modelling provides more insight into the relationship between fitness and academic and non-academic outcomes. Our methodology took advantage of the rich, student-level records that are available at the ERC and that are collected by the FitnessGram® web application.

In this chapter, the evaluation team uses more rigorous multivariate statistical models to address the research questions that were previously explored using descriptive and correlational analyses in Chapter 2, with one important exception – the results in Chapter 3 control for compositional differences (i.e., demographic, socioeconomic, English language learner status, special education program participation, prior academic achievement, prior attendance, and disciplinary referral rates) between students to arrive at estimates of the impact of attaining HFZ status and various student outcomes described below in research questions 3.1 through 3.5. Using this approach, the research team produced an estimate of the relationship between fitness and academic outcomes that is separate from any relationship between other observed student characteristics, such as economic disadvantaged status and academic outcomes that are included in the multivariate model. Thus, the research team was able to make estimates based on associations between the measures adjusted for malleable (e.g., prior test scores and fitness scores) and invariant (e.g., gender or race/ethnicity) student characteristics. For instance, after controlling for student differences, achieving Aerobic Capacity HFZ status is associated with a higher percentile rank in their STAAR reading scale score.

The research questions addressed in this chapter include:

- Research Question 3.1: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and STAAR Performance?
- Research Question 3.2: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and student attendance?
- Research Question 3.3: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and student obesity?

- Research Question 3.4: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and participation in school meal programs?
- Research Question 3.5: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and participation in school meal programs?

School-level conditions can also influence student outcomes, and to account for this, the research team used a multilevel model which includes school-level means for student characteristics.[20] In addition to the statistical models used to account for school-level characteristics independent of student-level characteristics, the evaluation team also accounted for the students' prior performance on the outcomes of interest.[21] Models were run separately by gender, as different effects for male and female students are often found, and modeling them separately is most typical in the literature. Separate models were also run by school level (i.e., elementary, middle, and high school) to determine if different effects were observable at the three school levels.

In addition to the research approach described above, the evaluation team developed statistical models which examined the relationship between changes in a student's health status (e.g., meeting HFZ thresholds in two of the four metrics and 2014–15 and four of the HFZ metrics in 2015–16) and changes in academic and non-academic results between those two school years.

Multivariate Relationship Between Physical Fitness Metrics and Academic Outcomes

Research Question 3.1: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and STAAR performance?

We explored the statistical relationship between students meeting HFZ standards for the six FitnessGram® measures and their percentile rank on the STAAR mathematics exam. The analytic sample for the multivariate analyses are described in Appendix B of this report.

Figure 3.1 shows that the largest difference for male students was observed for the Aerobic Capacity measure, where being in the Aerobic Capacity HFZ was associated with male students scoring 1.35 percentile-ranked percentage points higher on the STAAR mathematics in 2014–15 and 1.03 percentage points higher in 2015–16. [22] The second largest association was observed

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[20]See Rauner, R. R., Walters, R. W., Avery, M., & Wanser, T. J. (2013). Evidence that aerobic fitness is more salient than weight status in predicting standardized math and reading outcomes in fourth-through eighth-grade students. The Journal of Pediatrics, 163(2), 344-348.

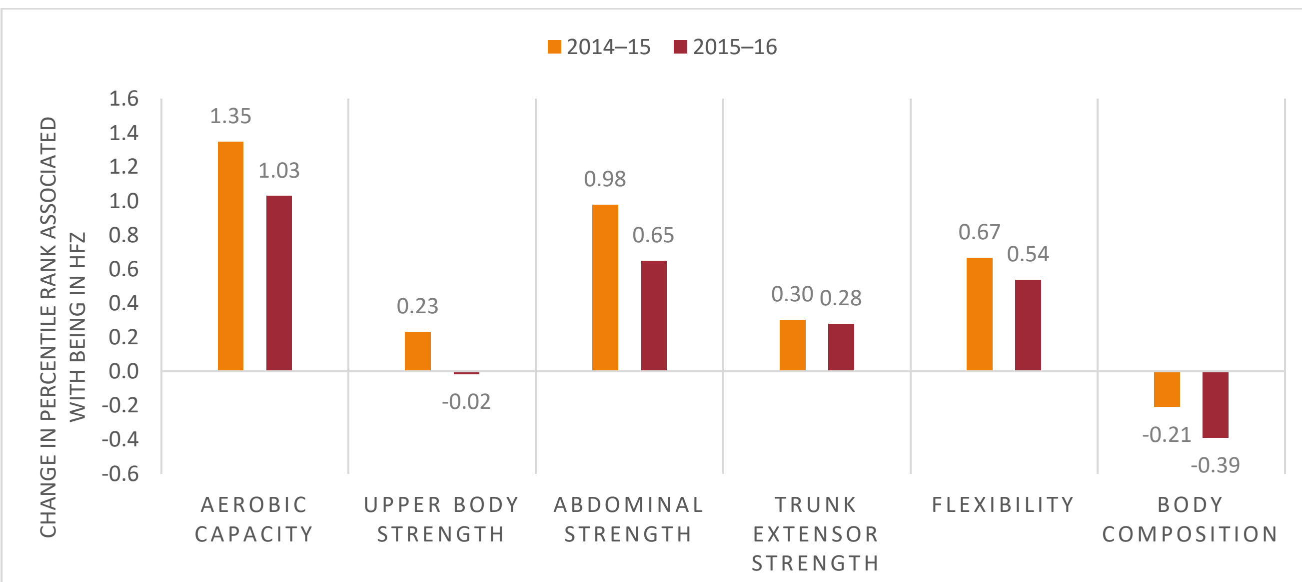
[21] For years where the prior year's data is available and where student records can be linked across years.

[22] For all figures with multivariate model results in this report, the source data were derived from the years indicated in the figure title as well as one academic year prior. The reason for this is that lagged outcome variables

for the Abdominal Strength measure. Being in the Abdominal Strength HFZ was associated with male students scoring 0.98 percentage points higher on the STAAR mathematics in 2014–15 and 0.65 percentage points higher in 2015–16. Being in the Flexibility HFZ was associated with male students having a score that was 0.67 percentage points higher on the STAAR mathematics in 2014–15 and 0.54 percentage points higher in 2015–16. All three of the findings were statistically significant. The adjusted mean score (or regression coefficient) for other FitnessGram® measures were quite small (i.e., less than 0.40).

While the magnitude of the adjusted mean changes in percentile rank scores due to being in each HFZ are small, they are substantively important. That is, the adjusted change in average percentile rank score might increase by about 5 points for students who are not economically disadvantaged, for instance, the change due to being in the Aerobic Capacity HFZ is more than 20% in size when compared to this effect. In addition, as shown later in the report, the relationship between measures and student achievement are cumulative: being in more than one of the HFZs often results in a higher overall increase in the predicted percentile rank score for a student.

Figure 3.1. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank Score, 2014–15 and 2015–16, Male Students



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics, 2013-14, 2014–15, and 2015–16, Texas Education Agency.Note: A total of 421,256 students were included in the 2014–15 analyses and 543,506 students were included in the 2015–16 analyses. With the exception of Upper Body Strength in 2014–15 and 2015–16 and Trunk Extensor Strength for 2014–15, all relationships were statistically significant at the .05 level or better.

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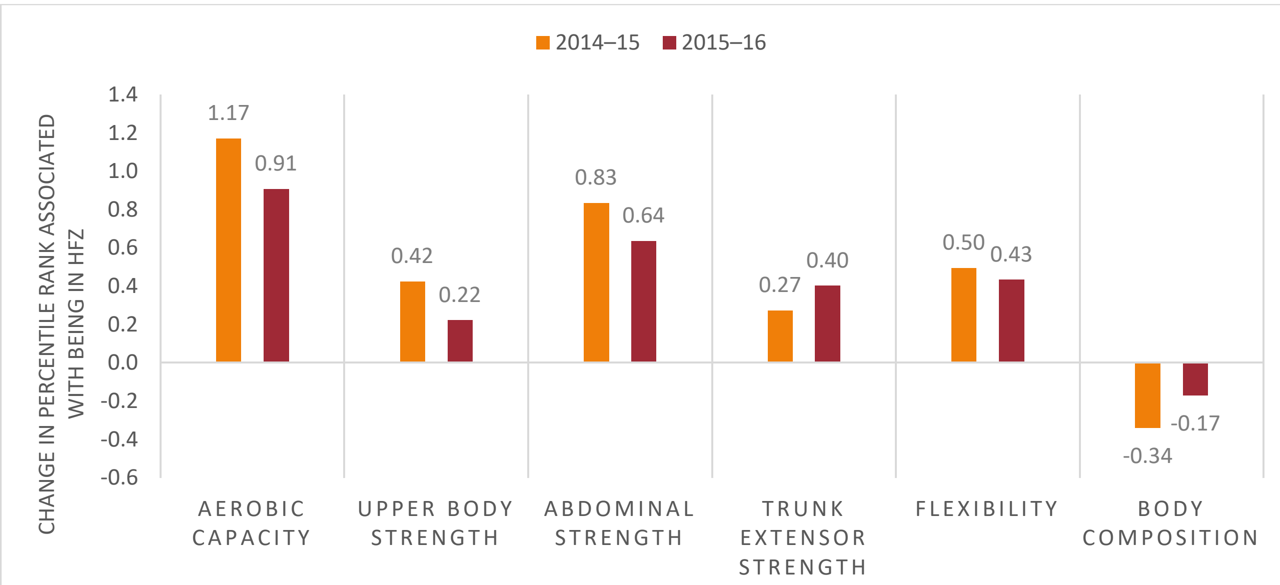
were used in the model. So for a model run on 2014-15 the source data would include 2013-14 and 2014-15 records.

While similar results were found for female students, the effects were smaller than those for males. Being in the Aerobic Capacity HFZ was associated with being ranked 1.17 percentage point higher on the STAAR mathematics in 2014–15 and 0.91 percentage points higher in 2015–16. Being in the Abdominal Strength HFZ was associated with female students being ranked 0.83 percentage points higher on the STAAR mathematics in 2014–15 and 0.64 percentage points higher in 2015–16 (Figure 3.2).

Being in the Flexibility HFZ was associated with being ranked 0.50 percentage points higher for female students on the STAAR mathematics in 2014–15 and 0.43 percentage points higher in 2015–16.

Figure 3.2. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank Score, 2014–15 and 2015–16, Female Students



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics, 2013-14, 2014–15, and 2015–16, Texas Education Agency.

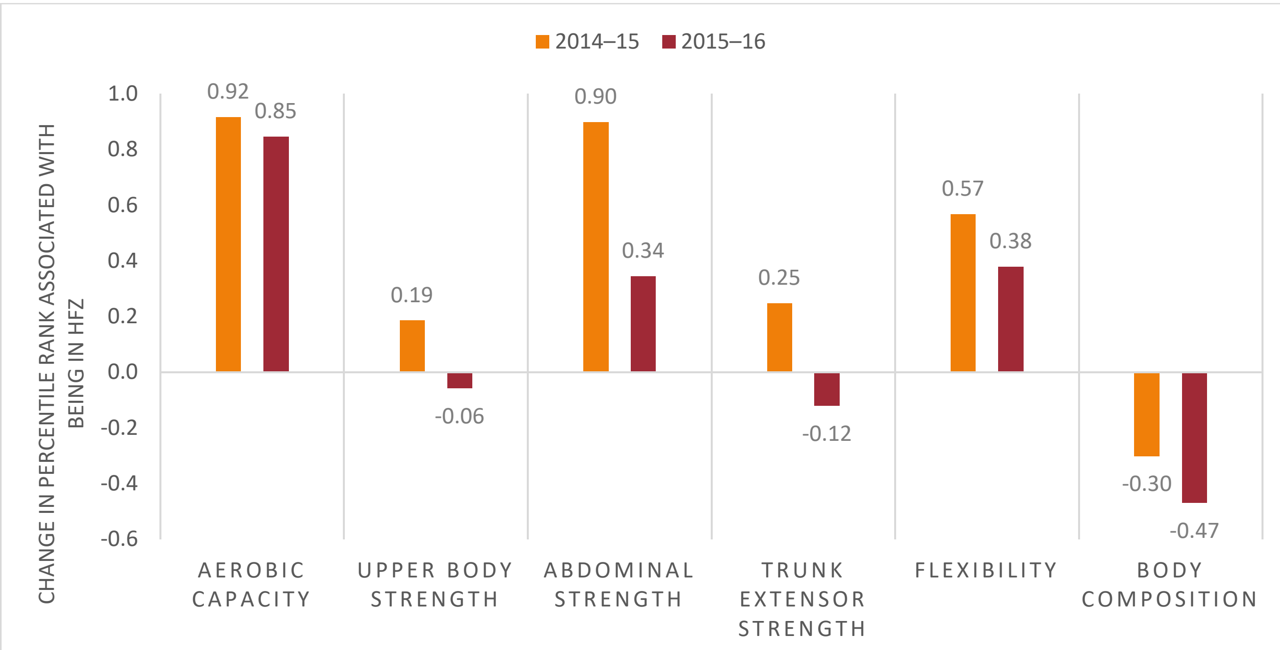
Note: A total of 402,340 students were included in the 2014–15 analyses and 514,308 students were included in the 2015–16 analyses. With the exception of Trunk Extensor Strength in 2014 – 15, all relationships were statistically significant at the .05 level or better.

When the relationship between HFZ attainment for the six FitnessGram® measures and percentile rank score on the STAAR reading exam was explored for male and female students, the same metrics emerged with the strongest association with STAAR reading: 1) Aerobic Capacity; 2) Abdominal Strength; and 3) Flexibility. This finding held regardless of gender or year of data being examined.

As Figure 3.3 illustrates, for male students, attaining the Aerobic Capacity HFZ was associated with being ranked 0.92 percentage points higher on the STAAR reading in 2014–15 and 0.85 percentage points higher in 2015–16. Being in the Abdominal Strength HFZ was associated with being ranked 0.90 percentage points higher on the STAAR reading in 2014–15 and 0.34

percentage points higher in 2015–16. Lastly, being in the Flexibility HFZ was associated with being ranked 0.57 percentage points higher on the STAAR reading in 2014–15 and 0.38 percentage points higher in 2015–16.

Figure 3.3. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2014–15 and 2015–16, Male Students



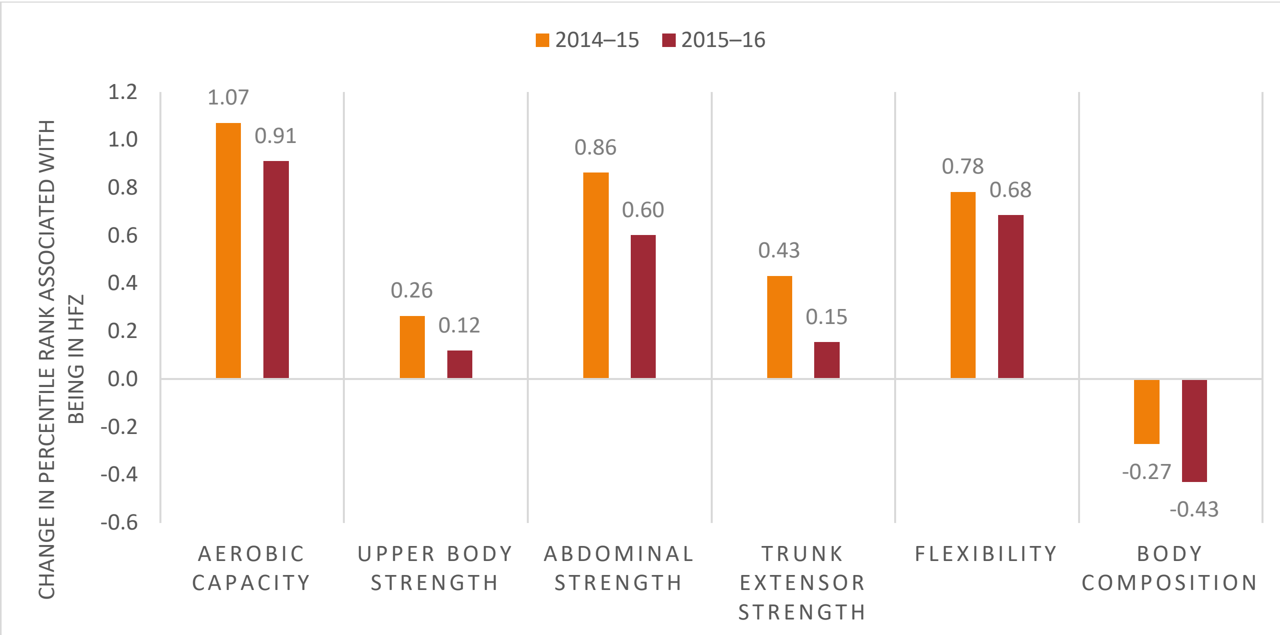
Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for reading, 2013-14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 445,639 students were included in the 2014–15 analyses and 580,309 students were included in the 2015–16 analyses. With the exception of Upper Body Strength in 2015–16 and Trunk Extension in 2014–15 and 2015–16, all relationships were statistically significant at the .05 level or better.

As Figure 3.4 illustrates, for female students, being in the Aerobic Capacity HFZ was associated with being ranked 1.07 percentage points higher on the STAAR reading in 2014–15 and 0.91 percentage points higher in 2015–16. The estimates for Aerobic Capacity were slightly larger for female students than for males, which is a reversal from the STAAR mathematics findings.

Being in the Abdominal Strength HFZ was associated with female students being ranked 0.86 percentage points higher on the STAAR reading in 2014–15 and 0.60 percentage points higher in 2015–16. Meeting the HFZ threshold for Flexibility was associated with being ranked 0.78 percentage points higher for female students on the STAAR reading in 2014–15 and 0.68 percentage points higher in 2015–16.

Figure 3.4. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2014–15 and 2015–16, Female Students



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for reading, 2013-14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 424,279 students were included in 2014–15 analyses and 547,122 students were included in the 2015–16 analyses. With the exception of Upper Body Strength in 2015–16 and Trunk Extensor Strength for 2015–16, all relationships were statistically significant at the .05 level or better.

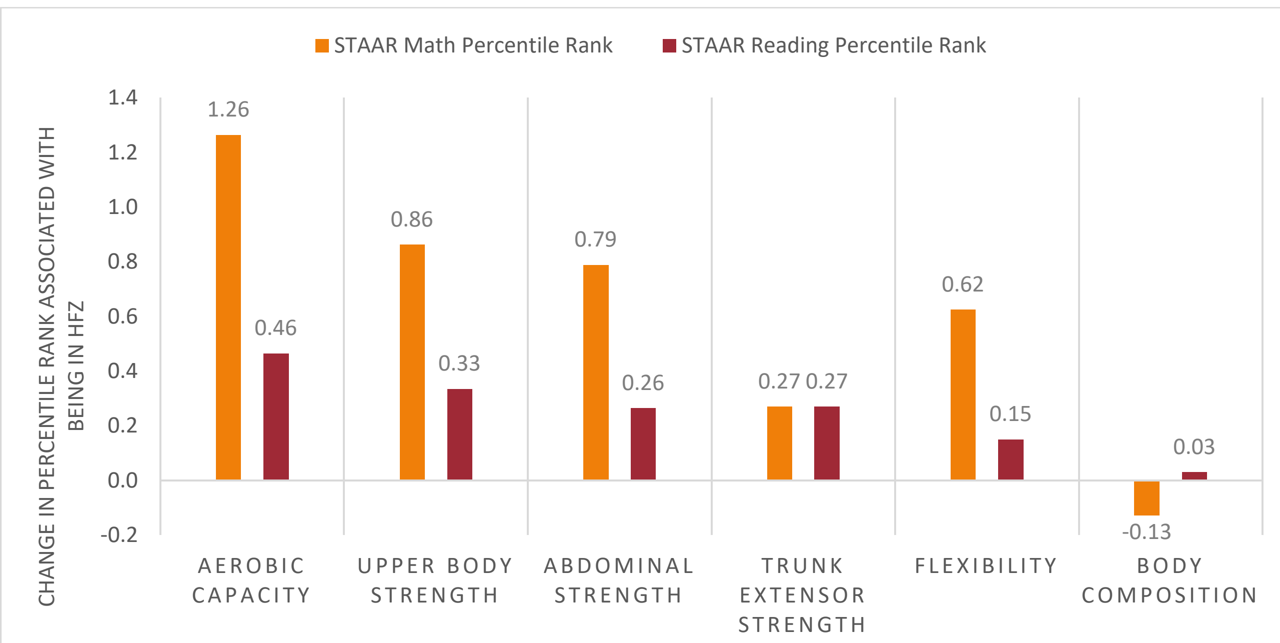
Association of Changes in Fitness Levels Between 2014–15 and 2015–16 and Academic Outcomes

The evaluation team also explored the relationship between changes in fitness from one year (2014–15) to the next (2015–16) and STAAR mathematics and reading outcomes for male and female students. Modeling how changes in fitness are related to changes in outcomes, and finding similar results, increases confidence that the results are due to a real relationship. If both the level and changes in the outcome of interest are predicted by a factor, it is more likely that the relationship is not a product of association with some other variable. The results from the analyses are consistent with the findings presented in figures 3.1 – 3.4 in that being fit was associated with modest improvements in mathematics and reading outcomes, and that the impacts were larger for mathematics than they were for reading.

As Figure 3.5 illustrates, for male students with improved fitness (moving from not being in a HFZ in 2014–15 to meeting HFZ thresholds in 2015–16) is associated with statistically higher percentile rankings on STAAR mathematics and STAAR reading exams in 2015–16 for the following FitnessGram® measures:

- Aerobic Capacity: STAAR mathematics (+1.26 percentage points); STAAR reading (+0.46 percentage points);
- Upper Body Strength: STAAR mathematics (+0.86 percentage points); STAAR reading (+0.33 percentage points);
- Abdominal Strength: STAAR mathematics (+0.79 percentage points); STAAR reading (+0.26 percentage points); and
- Flexibility: STAAR mathematics (+0.62 percentage points); STAAR reading (+0.15 percentage points).

Figure 3.5. – Multivariate Results Between Changes in FitnessGram® HFZ Attainment Between 2014–15 and 2015–16 and STAAR Mathematics and STAAR Reading Percentile Rank, Male Students



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2013-14, 2014–15, and 2015–16, Texas Education Agency.

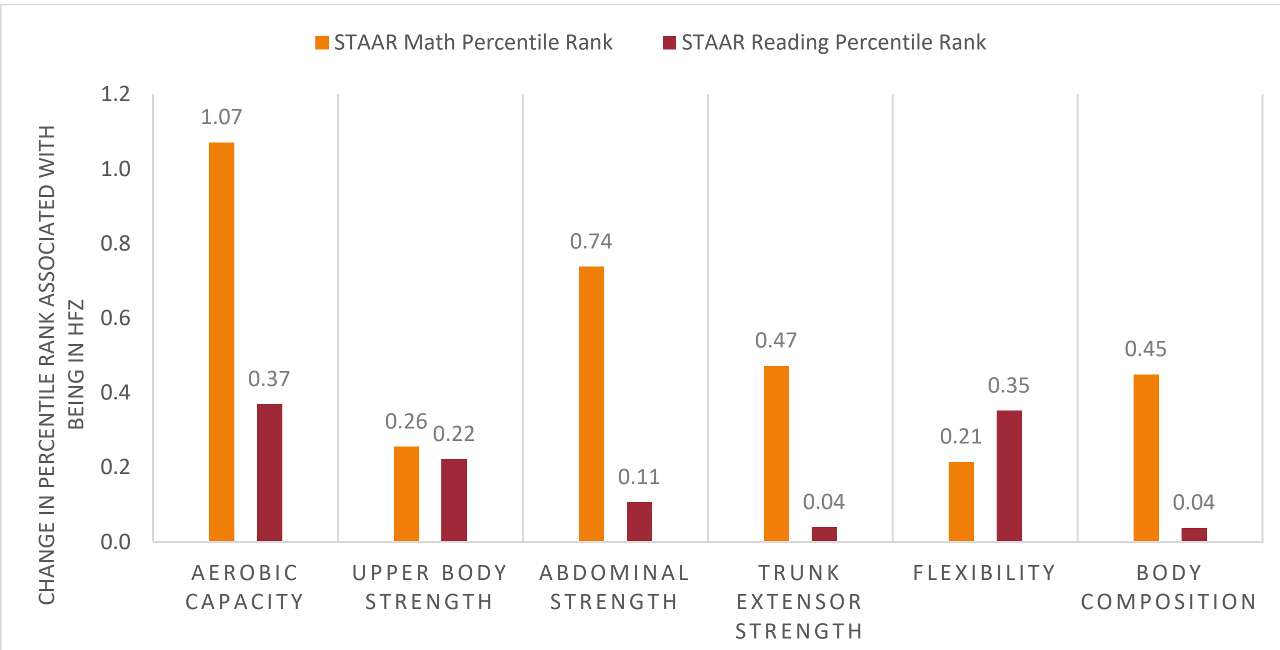
Note: A total of 228,193 male students were included in the STAAR mathematics analyses and 242,395 male students were included in the STAAR reading analyses. With the exception of Upper Body Strength for reading, Trunk Extensor Strength for mathematics and reading, and Flexibility for reading, all relationships were statistically significant at the .05 level or better.

For female students, the largest association between changes in fitness results and 2015–16 STAAR mathematics and STAAR reading percentile rankings was for the Aerobic Capacity and Abdominal Strength measures. As Figure 3.6 illustrates, female students who improved fitness (moving from not being in a HFZ in 2014–15 to meeting HFZ thresholds in 2015–16) is associated with statistically higher percentile rankings on STAAR mathematics and STAAR reading exams in 2015–16 for the following FitnessGram® measures:

- Aerobic Capacity: STAAR mathematics (+1.07 percentage points); STAAR reading (+0.37 percentage points);
- Abdominal Strength: STAAR mathematics (+0.74 percentage points); STAAR reading (+0.11 percentage points).

Similar to the findings for male students, the differences for female students were much more significant for mathematics than for reading.

Figure 3.6. – Multivariate Results Between Changes in FitnessGram® HFZ Attainment Between 2014–15 and 2015–16 and STAAR Mathematics and STAAR Reading Percentile Rank, Female Students



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2013-14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 218,296 female students were included in the STAAR mathematics analyses and 230,227 female students were included in the STAAR reading analyses. With the exception of Upper Body Strength for mathematics and reading, Abdominal Strength for reading, Trunk Extensor Strength for reading, Flexibility for mathematics and reading, and Body Composition for reading, all relationships were statistically significant at the .05 level or better.

Results Disaggregated School Level (Elementary, Middle, and High School)

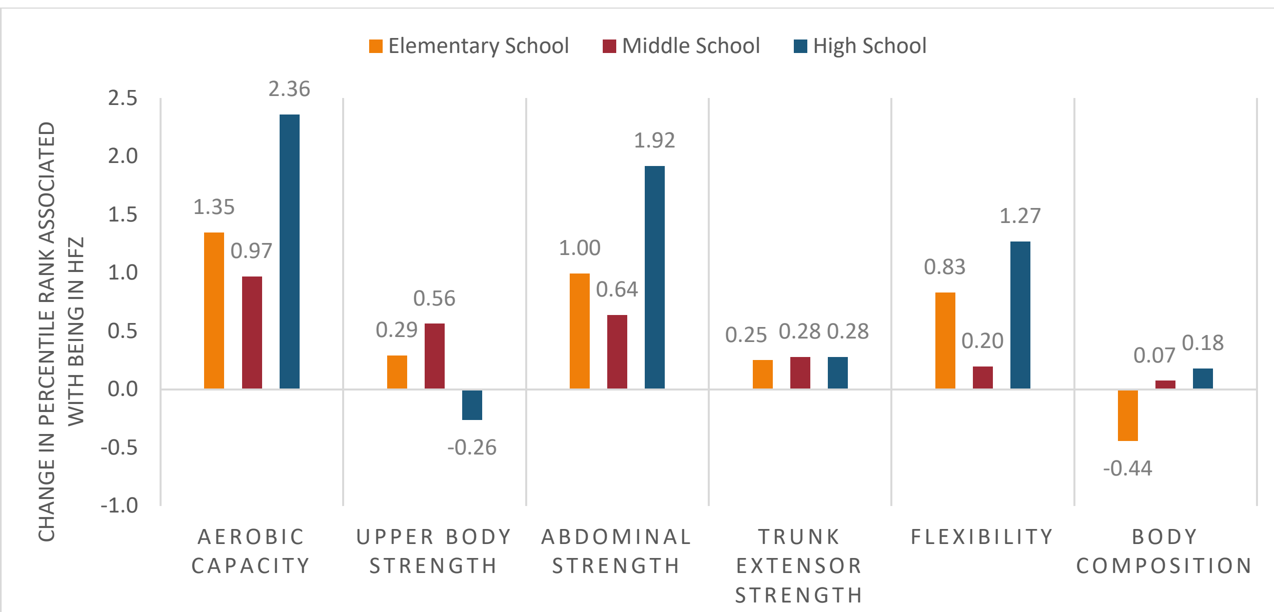
To gain a better understanding of the differential effects of being in a HFZ and STAAR mathematics and STAAR reading outcomes, the evaluation team further disaggregated findings to the school level by running separate regression models for male and female students enrolled at elementary schools, middle schools, and high schools.

Male Student Results by School Level

As Figure 3.7 shows, the relationship between three of the six FitnessGram® measures (Aerobic Capacity, Abdominal Strength, and Flexibility) and STAAR mathematics percentile rank for male students is larger at the high school level than the elementary and middle school levels in 2014–15. For instance, a male student in the Aerobic Capacity HFZ in high school is associated with a 2.36 percentage point increase in STAAR mathematics percentile rank. In contrast, elementary school male students in the HFZ for this measure is associated with a 1.35 percentage point increase in STAAR mathematics percentile ranking and a 0.97 percentage point increase for middle school students.

Similarly, a male student in the Abdominal Strength HFZ in high school is associated with a 1.92 percentage point increase in STAAR mathematics percentile rank compared to a one percentage point increase in STAAR mathematics percentile ranking for elementary school students and a 0.64 percentage point increase for middle school students. A male student meeting the HFZ threshold for the Flexibility measure in high school is associated with a 1.27 percentage point increase in STAAR mathematics percentile rank compared to 0.83 percentage point increase in STAAR mathematics percentile ranking for elementary school students and a modest 0.20 percentage point increase for middle school students.

Figure 3.7. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, 2014–15, Male Students by School Level

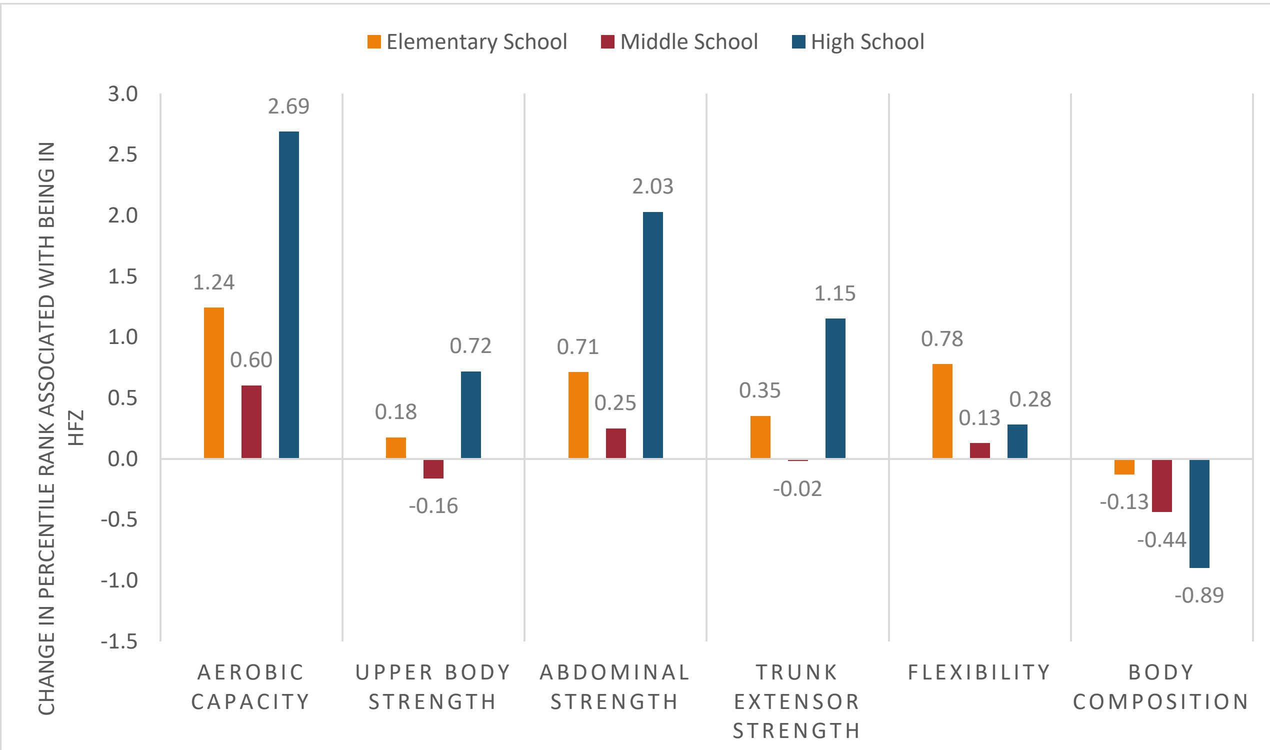


Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2013-14 and 2014–15, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics, 2013-14 and 2014–15, Texas Education Agency.

Note: A total of 207,419 male elementary school students, 163,974 male middle school students, and 29,790 male high school students were included in the 2014–15 analyses. With the exception of Upper Body Strength in middle and high school students, Trunk Extensor Strength in students at all three school levels, Flexibility in middle school students, and Body Composition in middle and high school students, all relationships were statistically significant at the .05 level or better.

Figure 3.8 confirms that the school level differentiation in the relationship between HFZ attainment and STAAR mathematics results for male students is not isolated to the 2014–15 school year, as the association between being in the HFZ for Aerobic Capacity (+2.69 percentage points), Abdominal Strength (+2.03 percentage points), and Flexibility (+1.15 percentage points) and STAAR mathematics percentile rankings was higher for male high school students than their elementary school or middle school counterparts in 2015–16.

Figure 3.8. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, 2015–16, Male Students by School Level



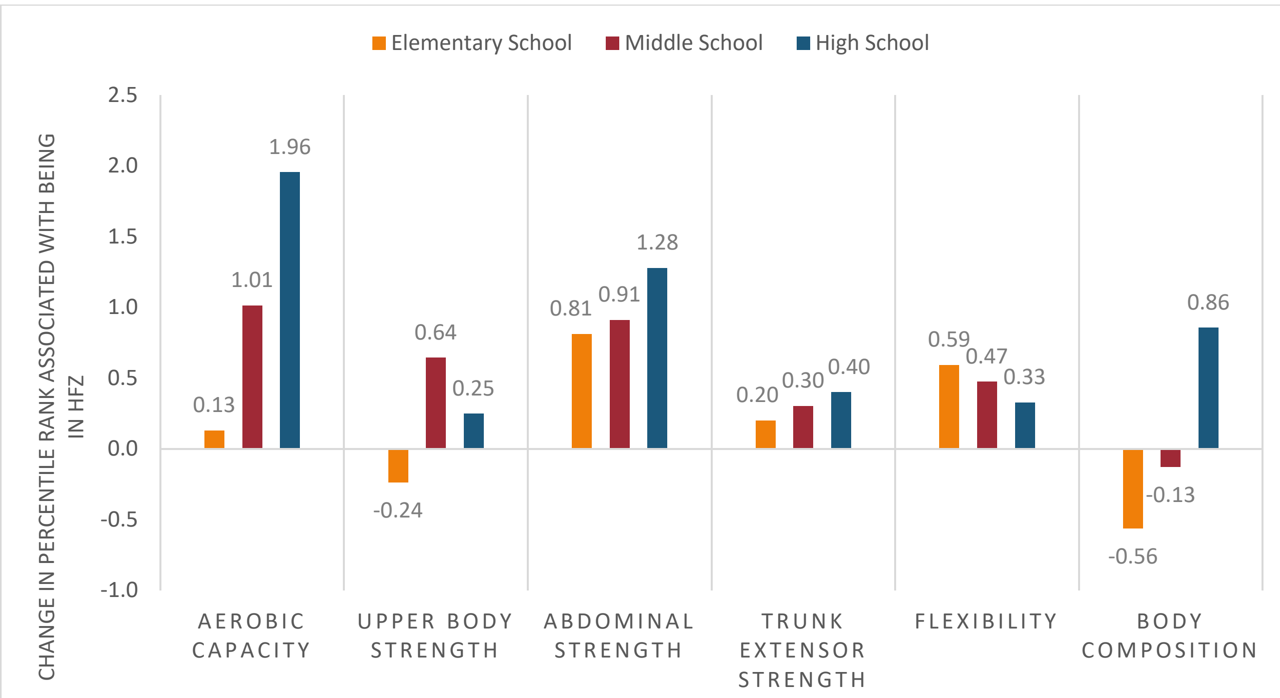
Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics, 2014–15 and 2015–16, Texas Education Agency.

Note: A total of 253,886 male elementary school students, 208,419 male middle school students, and 45,173 male high school students were included in the 2015–16 analyses. With the exception of Upper Body Strength in elementary and middle school students, Abdominal Strength in middle school students, Trunk Extensor Strength in middle school students, Flexibility in middle and high school students, and Body Composition in elementary students, all relationships were statistically significant at the .05 level or better.

As Figure 3.9 illustrates, school level differentiation in the relationship between HFZ attainment and STAAR reading results for male students mirror that of the STAAR mathematics results shown in Figures 3.7 and 3.8 for Aerobic Capacity and Abdominal Strength (to some extent), but not for Flexibility (where the high school difference is less significant than that for elementary and middle school students) in 2014–15. A male student in the Aerobic Capacity HFZ in high school is associated with a 1.96 percentage point increase in STAAR reading percentile rank compared to 0.13 percentage point increase in STAAR reading percentile ranking for elementary school students and a 1.01 percentage point increase for middle school students.

Likewise, a male student meeting the HFZ threshold for the Abdominal Strength measure in high school is associated with a 1.28 percentage point increase in STAAR reading percentile rank compared to 0.81 percentage point increase in STAAR reading percentile ranking for elementary school students and 0.91 percentage point increase for middle school students. In addition, being in the Body Composition HFZ for male high school students was associated with a positive increase in reading percentile ranking (+0.86 percentage points) as opposed to small negative associations observed at the elementary (-0.56 percentage points) and middle school (-0.13 percentage points) levels.

Figure 3.9. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2014–15, Male Students



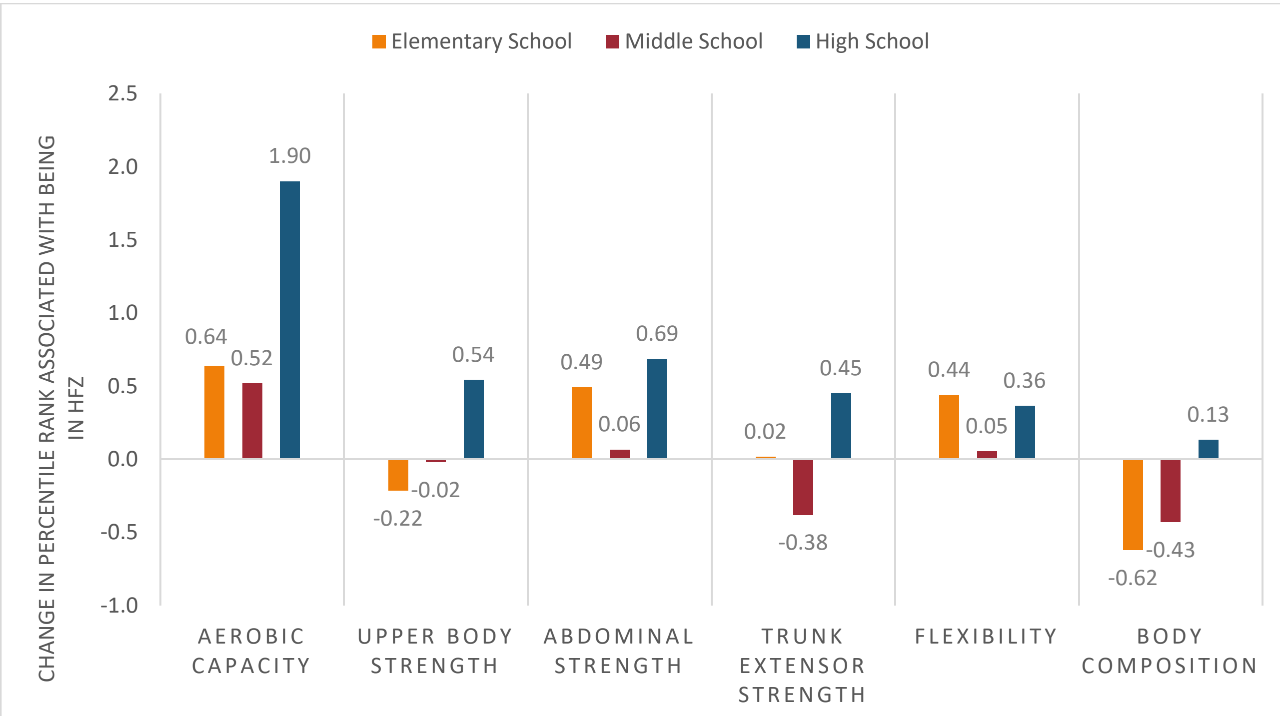
Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2013-14 and 2014–15, and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2013-14 and 2014–15, Texas Education Agency.

Note: A total of 207,526 male elementary school students, 164,078 male middle school students, and 52,787 male high school students were included in the 2014–15 analyses. With the exception of Aerobic Capacity in elementary school students, Upper Body Strength in elementary and high school students, Trunk Extensor Strength in students at all three school levels, Flexibility in high school students, and Body Composition in middle school students, all relationships were statistically significant at the .05 level or better.

Comparable results were observed for male high school students in 2015–16 for Aerobic Capacity with HFZ attainment associated with a 1.9 percentage point increase in reading percentile rankings compared to 0.64 percent for male elementary students and 0.52 percentage points for male middle school students.

In 2015–16 differences were also larger for male high school students in the Upper Body Strength, Abdominal Strength, and Trunk Extensor Strength FitnessGram® categories (Figure 3.10).

Figure 3.10. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2015–16, Male Students



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2014–15 and 2015–16, Texas Education Agency.

Note: A total of 253,884 male elementary school students, 208,428 male middle school students, and 79,662 male high school students were included in the 2015–16 analyses. With the exception of Upper Body Strength in middle school students, Trunk Extensor Strength in students at all three school levels, Abdominal Strength in middle school students, Flexibility in middle and high school students, and Body Composition in high school students, all relationships were statistically significant at the .05 level or better.

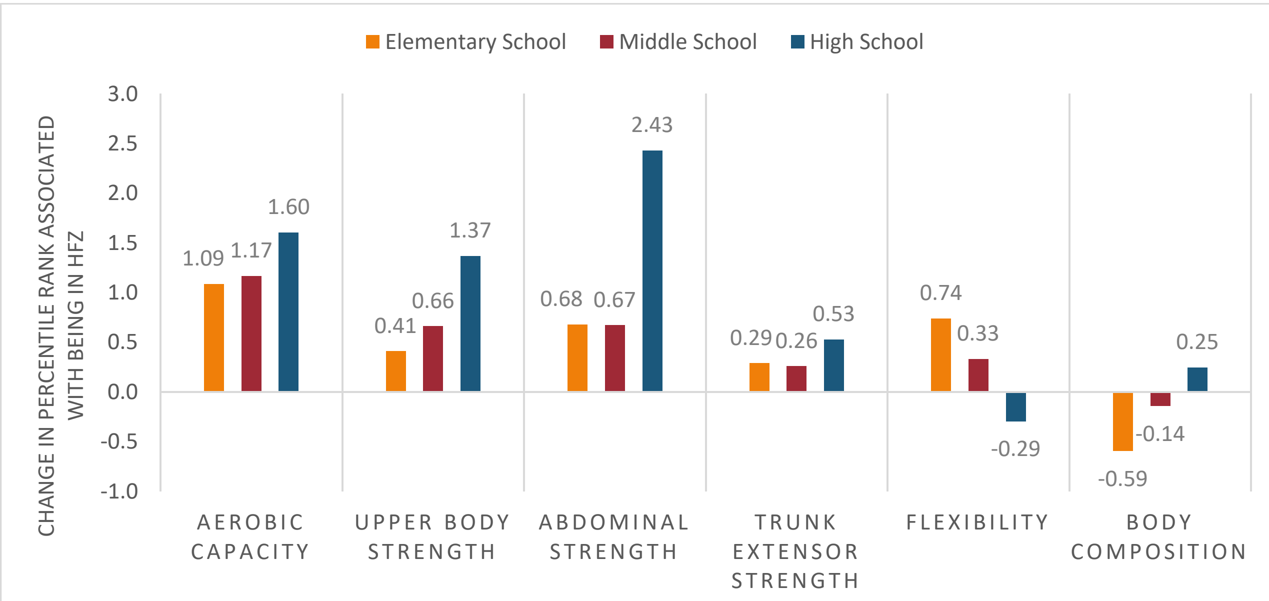
Female Student Results by School Level

The disaggregated regression results by school level for female students follow many of the same patterns as male students presented in Figures 3.7 – 3.10, with female high school students in 2014–15 and 2015–16 displaying larger associations between HFZ attainment and mathematics percentile rankings than their elementary and middle school peers on several FitnessGram® measures (i.e., Aerobic Capacity, Upper Body Strength, and Abdominal Strength). For a female high school student, meeting the threshold for the Aerobic Capacity HFZ was associated with a 1.6 percentage point and a 2.25 percentage point increase in 2014–15 and 2015–16 mathematics percentile ranking, respectively. Similarly, for a female high school student meeting the threshold for the Abdominal Strength HFZ was associated with a 2.43

percentage point and a 2.56 percentage point increase in 2014–15 and 2015–16 mathematics percentile ranking, respectively. For a female high school student, meeting the threshold for the Upper Body Strength HFZ was associated with a 1.37 percentage point and 1.24 percentage point increase in 2014–15 and 2015–16 mathematics percentile ranking, respectively (Figures 3.11 and 3.12).

The differences displayed in Figures 3.11 and 3.12 for female high school students are larger than those observed for female students in elementary and middle school grades.

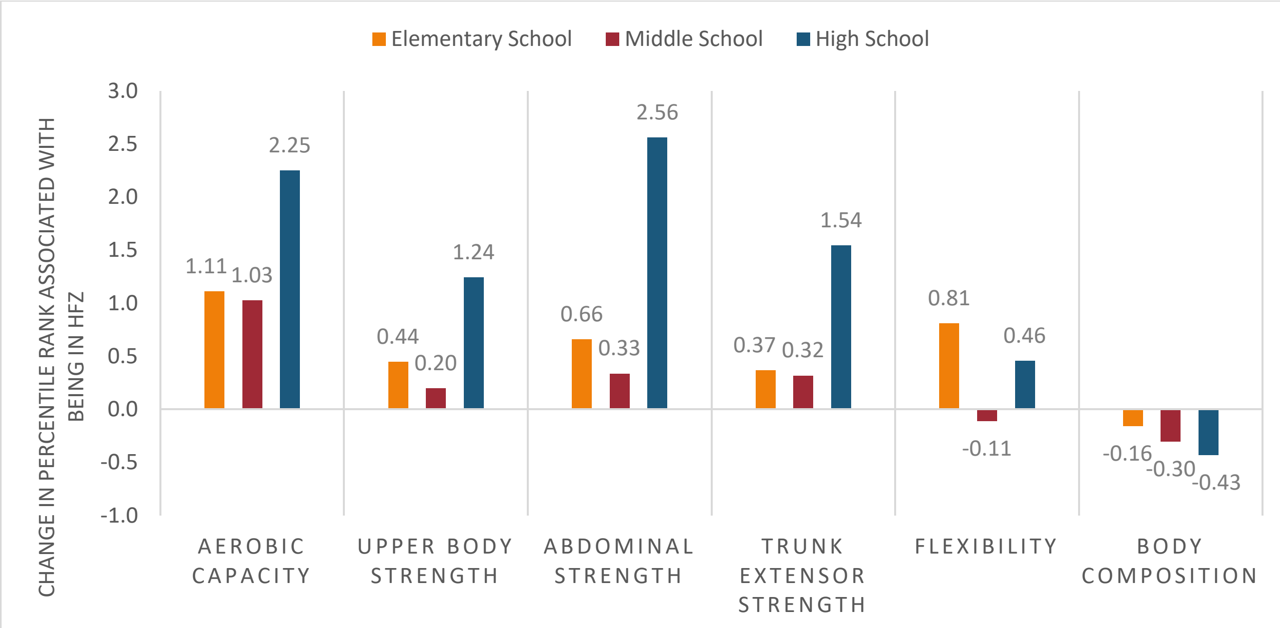
Figure 3.11. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, 2014–15, Female Students by School Level



Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2013-14 and 2014–15, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2013-14 and 2014–15, Texas Education Agency.

Note: A total of 199,797 female elementary school students, 155,236 female middle school students, and 25,829 female high school students were included in the 2014–15 analyses. With the exception of Trunk Extensor Strength in students at all three school levels, Flexibility in middle and high school students, and Body Composition in middle and high school students, all relationships were statistically significant at the .05 level or better.

Figure 3.12. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, 2015–16, Female Students by School Level



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2014–15 and 2015–16, Texas Education Agency.

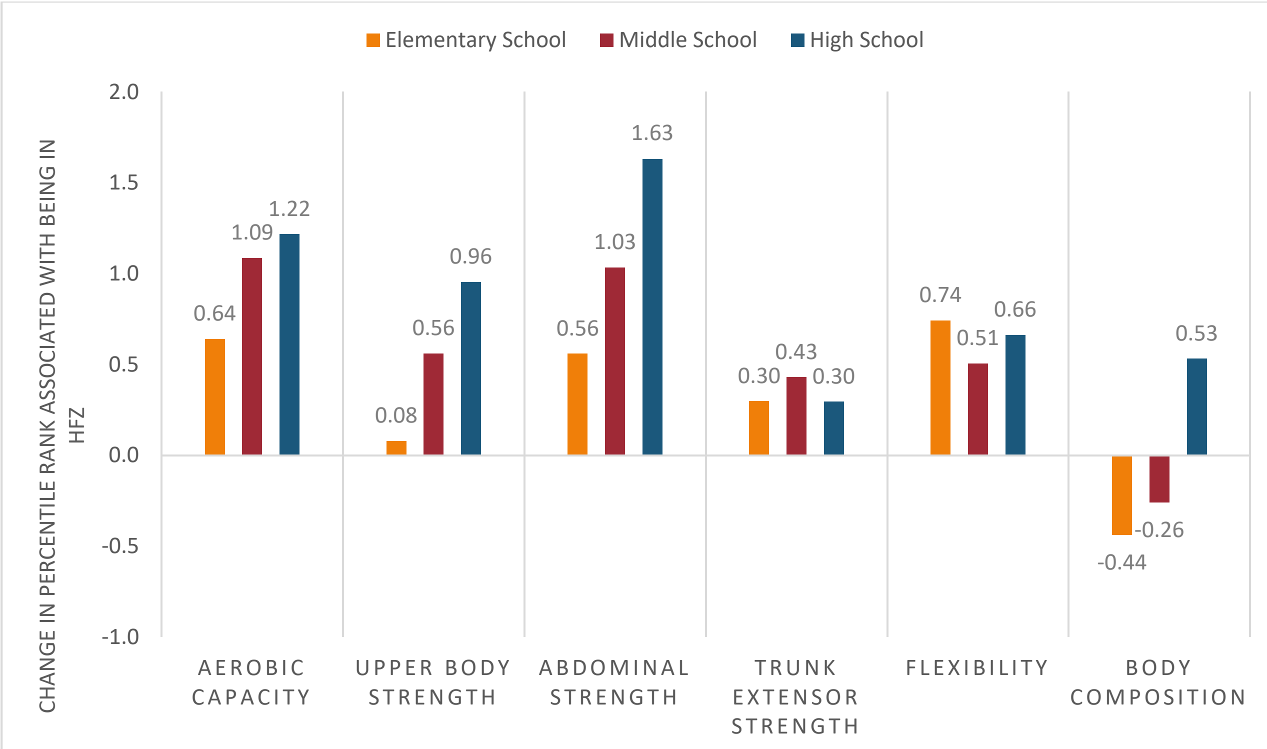
Note: A total of 242,161 female elementary school students, 197,670 female middle school students, and 38,060 female high school students were included in the 2015–16 analyses. With the exception of Upper Body Strength in middle school students, Abdominal Strength in middle school students, Trunk Extensor Strength in middle school students, Flexibility in middle and high school students, and Body Composition in elementary and high school students, all relationships were statistically significant at the .05 level or better.

As Figures 3.13 and 3.14 show, STAAR reading results for female students disaggregated by school level mirror the STAAR mathematics findings described above. The results reveal associations of larger magnitude between Aerobic Capacity, Upper Body Strength, and Abdominal Strength HFZ attainment and STAAR reading percentile rank for female high school students than for middle school and elementary school students. This finding held for both 2014–15 and 2015–16. Being in the Aerobic Capacity HFZ for high school female students was associated with an increase of 1.22 percentage points on STAAR reading percentile rank in 2014–15 and a 1.64 percentage point increase in 2015–16. Being in the Abdominal Strength HFZ for female high school students was associated with an increase of 1.63 percentage points on STAAR reading percentile rank in 2014–15 and a 1.50 percentage point increase in 2015–16.

Lastly, being in the Upper Body Strength HFZ for female high school students was associated with an increase of 0.96 percentage points on STAAR reading percentile rank in 2014–15 and a 0.8 percentage point increase in 2015–16.

The differences for female students in high school were larger than for elementary and middle school students.

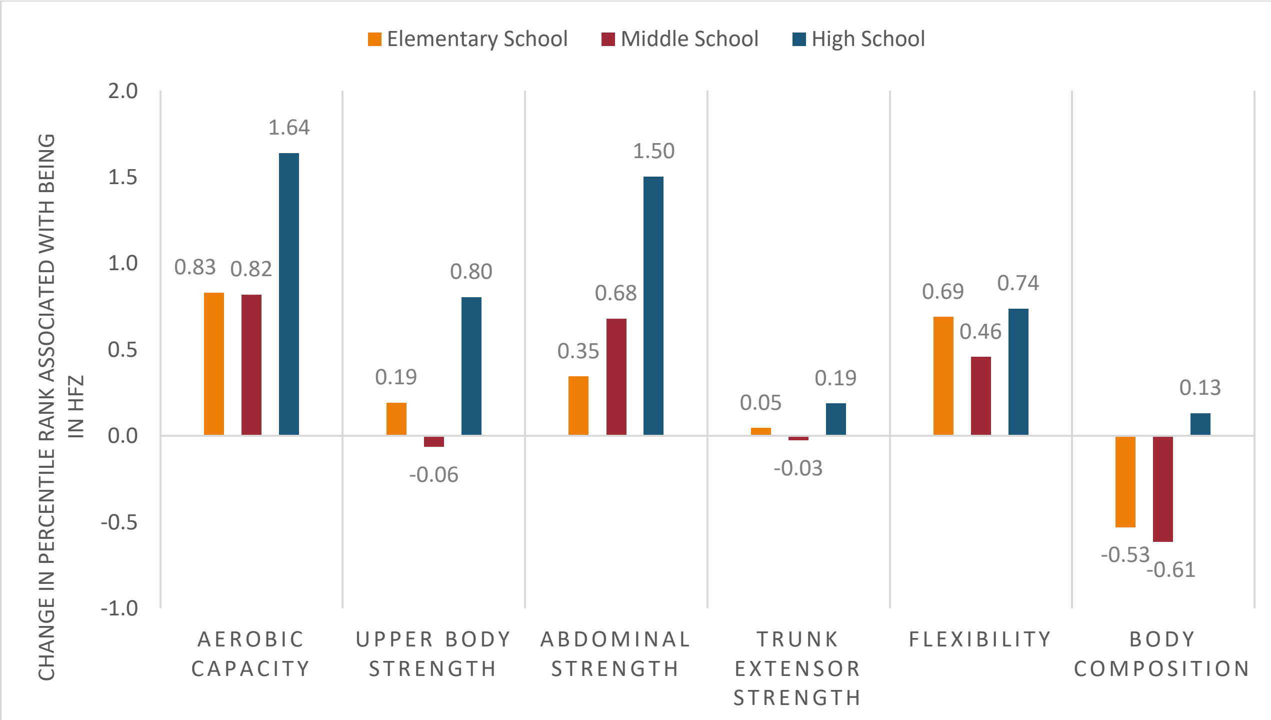
Figure 3.13. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2014–15, Female Students by School Level



Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2013-14 and 2014–15, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2013-14 and 2014–15, Texas Education Agency.

Note: A total of 199,869 female elementary school students, 155,325 female middle school students, and 46,360 female high school students were included in the 2014–15 analyses. With the exception of Upper Body Strength in elementary school students and Trunk Extensor Strength in students at all three school levels, all relationships were statistically significant at the .05 level or better.

Figure 3.14. – Multivariate Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2015–16, Female Students by School Level



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; State of Texas Assessments of Academic Readiness results for mathematics and reading, 2014–15 and 2015–16, Texas Education Agency.

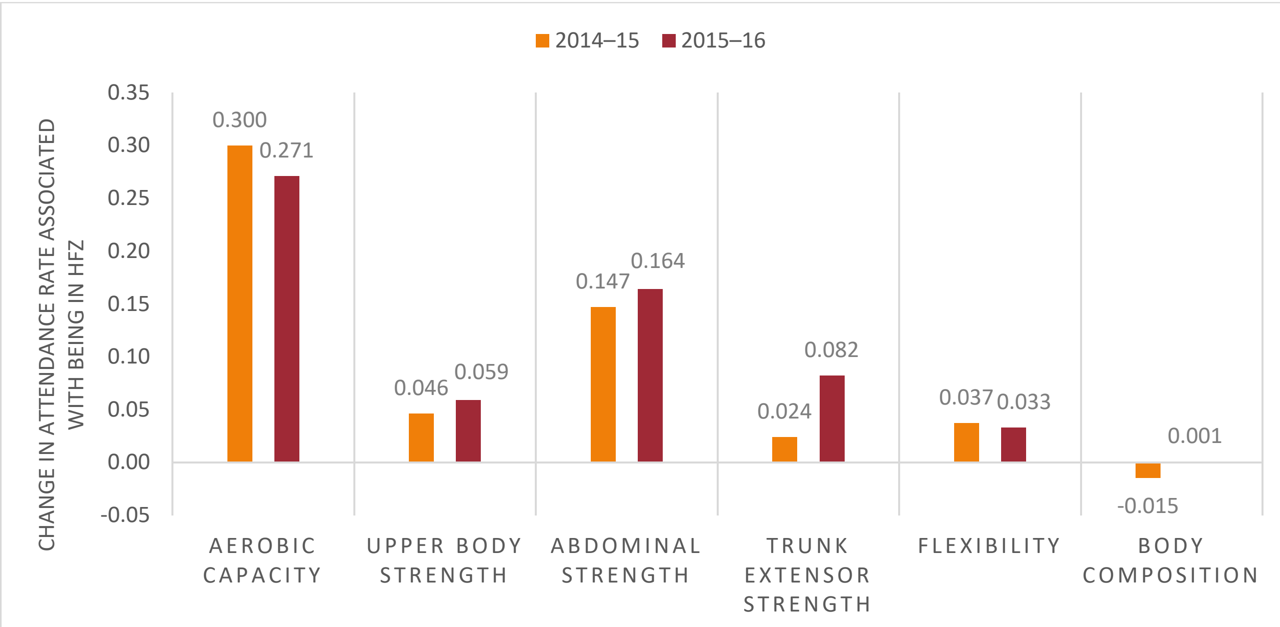
Note: A total of 242,161 female elementary school students, 197,660 female middle school students, and 68,674 female high school students were included in the 2014–15 analyses. With the exception of Upper Body Strength in elementary and middle school students, Trunk Extensor Strength in students at all three school levels, and Body Composition in high school students, all relationships were statistically significant at the .05 level or better.

Research Question 3.2: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and student attendance?

Attendance rate is defined as the percentage of days students were present in a given school year based on student enrollment for the entire school year. Figure 3.15 represents the association between a male student being in the HFZ for each of the six FitnessGram® metrics and regular school day attendance rate. Because attendance rates tend to be quite high (in the 95–96 percent range depending upon school year), and there is not a great deal of variation in attendance rates across students, it is not unexpected that estimates would be small in magnitude.

The association between fitness and attendance was of the largest magnitude for Aerobic Capacity where attaining the HFZ was associated with a 0.30 percentage point increase in attendance rate for 2014–15 and a 0.27 percentage point increase in attendance rate for 2015–16. For a male student, attaining the Abdominal Strength HFZ was associated with a 0.15 percentage point increase in attendance rate for 2014–15 and a 0.16 percentage point increase in attendance rate for 2015–16. Differences for other measures were even smaller (Figure 3.15).

Figure 3.15. – Multivariate Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2014–15 and 2015–16, Male Students

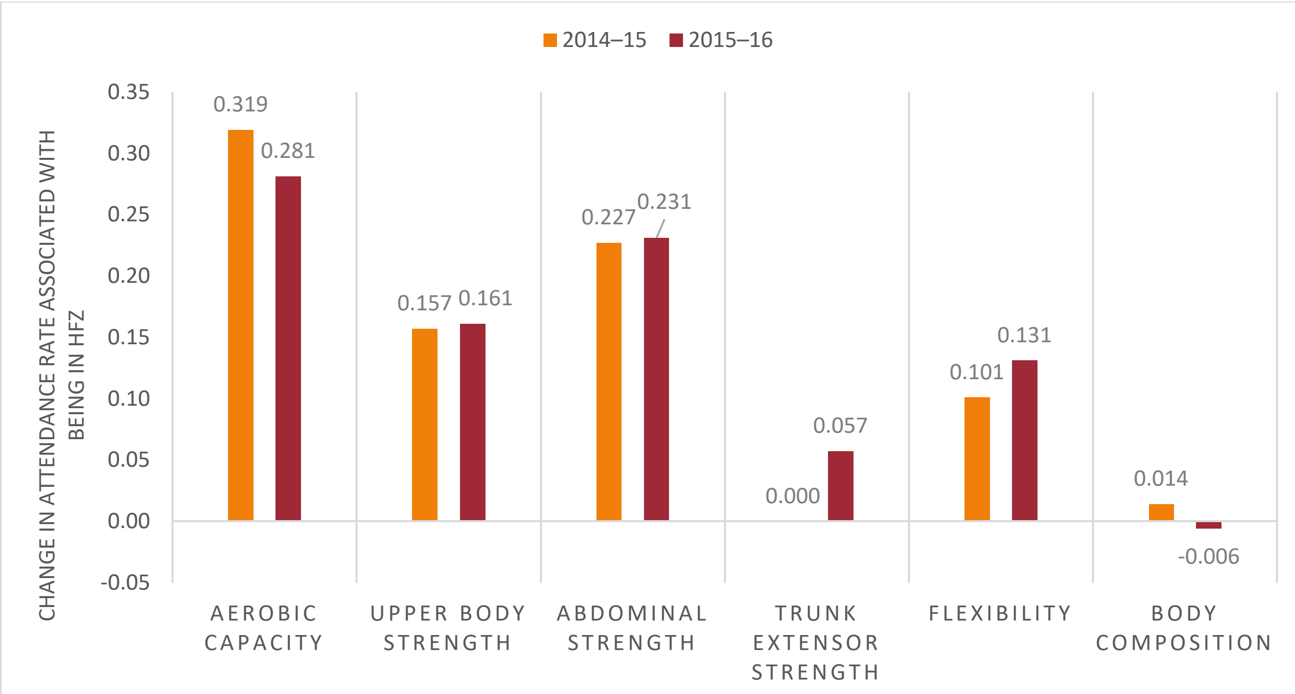


Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 426,157 students were included in the 2014–15 analyses and 641,896 students were included in the 2015–16 analyses. With the exception of Trunk Extensor Strength for 2014–15 and Body Composition for 2014–15 and 2015–16, all relationships were statistically significant at the .05 level or better.

As Figure 3.16 illustrates, comparable results were observed for female students, though the associations were larger for the Abdominal Strength measure for females than males. Being in the Aerobic capacity HFZ was associated with a 0.32 percentage point increase in attendance rate for 2014–15 and a 0.28 percentage point increase in attendance rate for 2015–16 for female students. For a female student, attaining the Abdominal Strength HFZ was associated with a 0.23 percentage point increase in attendance rate for both 2014–15 and 2015–16. The next two largest associations were for Upper Body Strength and Flexibility; however the estimated effect on the attendance rates was nominal.

Figure 3.16. – Multivariate Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2014–15 and 2015–16, Female Students



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013-14, 2014–15, and 2015–16, Texas Education Agency.

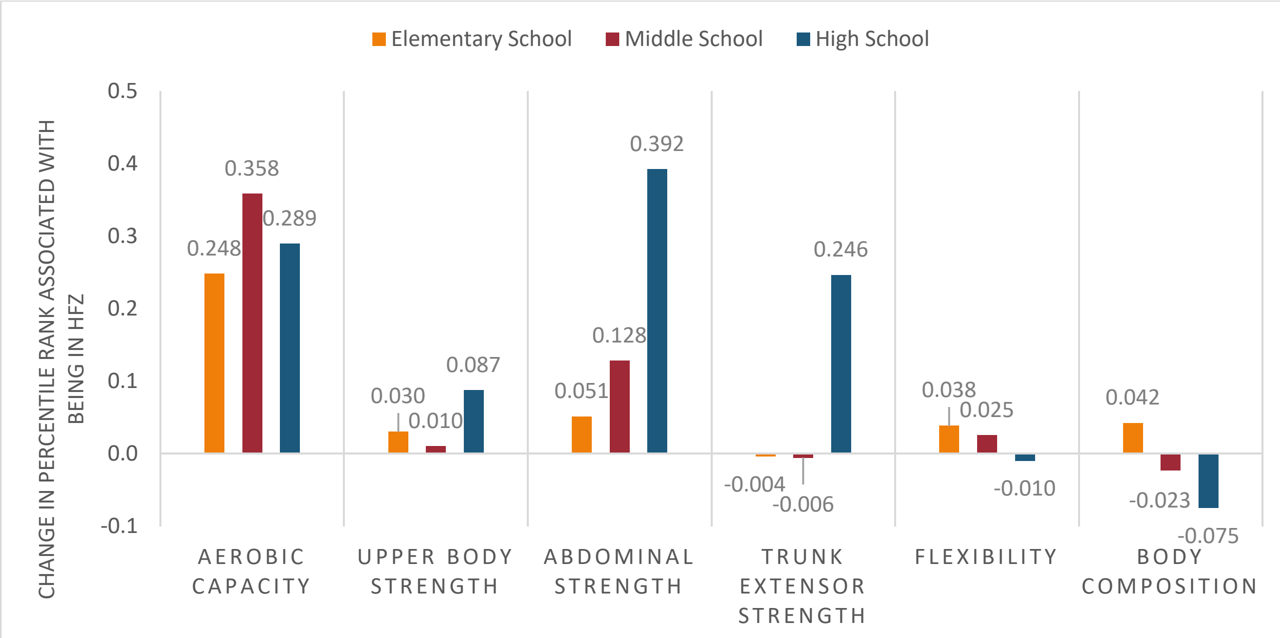
Note: A total of 399,459 students were included in the 2014–15 analyses and 596,386 students were included in the 2015–16 analyses. With the exception of Trunk Extensor Strength for 2014–15 and Body Composition for 2014–15 and 2015–16, all relationships were statistically significant at the .05 level or better.

When statistical models were run separately by school level and gender, differences emerged for some of the fitness metrics in terms of the strength of the relationship between HFZ status and the regular school day attendance rate. For instance, for a male high school student, attaining the Abdominal Strength HFZ was associated with a 0.39 percentage point increase in school attendance in 2014–15 and 0.32 percentage point increase in 2015–16, compared to smaller percentage point increases in attendance rate for middle school and elementary school students.

Similarly, there was no statistically significant association between male elementary or middle school students attaining the Trunk Extensor Strength HFZ and school attendance rate; however, a male high school student attaining the HFZ was associated with an attendance rate 0.25 percentage points higher in 2014–15 and 0.20 percentage points higher in 2015–16 (Figures 3.17 and 3.18).

In contrast, as Figure 3.17 shows, in 2014–15 the difference between being a male student in the Aerobic Capacity HFZ was larger for middle school students (+0.36 percentage points) than elementary school (+0.25 percentage points) and high school students (+0.29 percentage points).

Figure 3.17. – Multivariate Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2014–15, Male Students by School Level

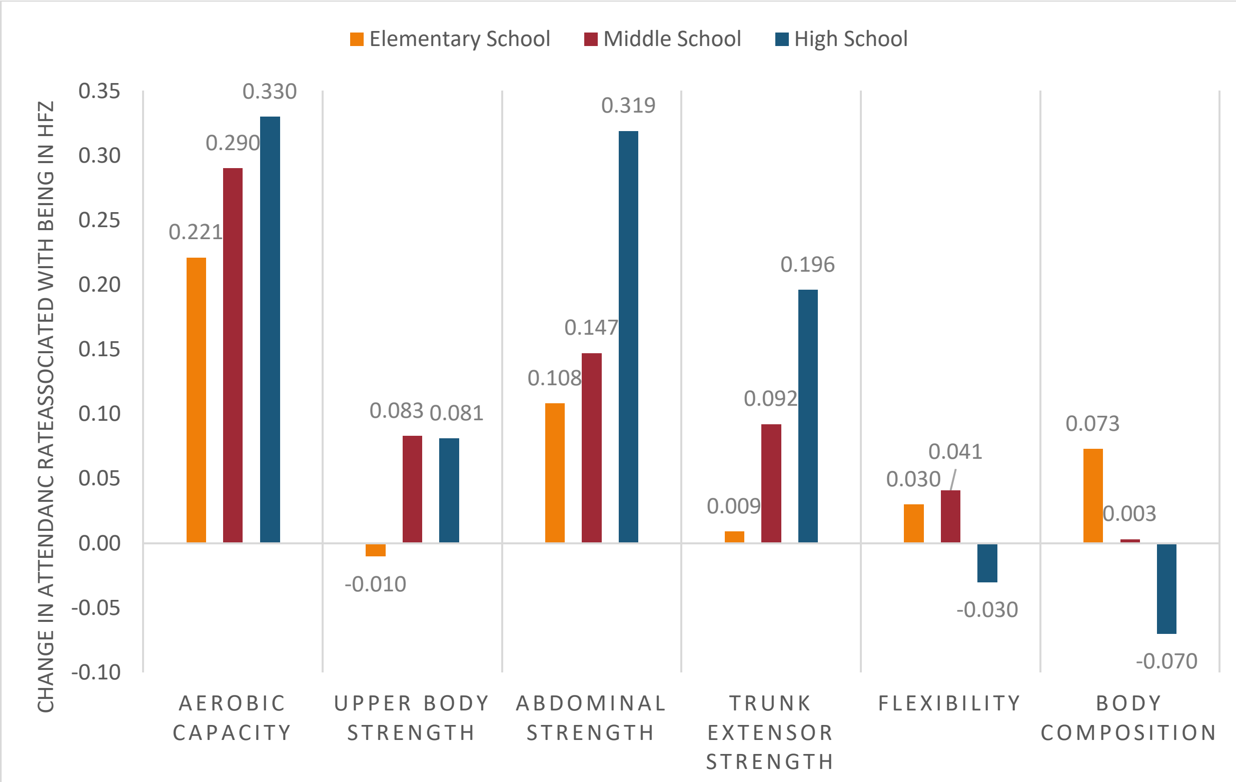


Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2013-14 and 2014–15, Texas Education Agency.

Note: A total of 189,337 male elementary school students, 145,617 male middle school students, and 71,453 male high school students were included in the 2014–15 analyses. With the exception of Upper Body Strength in students at all three school levels, Trunk Extensor Strength in elementary school students, Flexibility in middle and high school students, and Body Composition in middle and high school students, all relationships were statistically significant at the .05 level or better.

In 2015–16 (Figure 3.18), smaller differences in estimate size for Aerobic Capacity HFZ and attendance rate were observed between male high school (+0.33 percentage points) and middle school students (+0.29 percentage points). The difference was even less notable for elementary school males (+.22 percentage points).

Figure 3.18. – Multivariate Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2015–16, Male Students by School Level

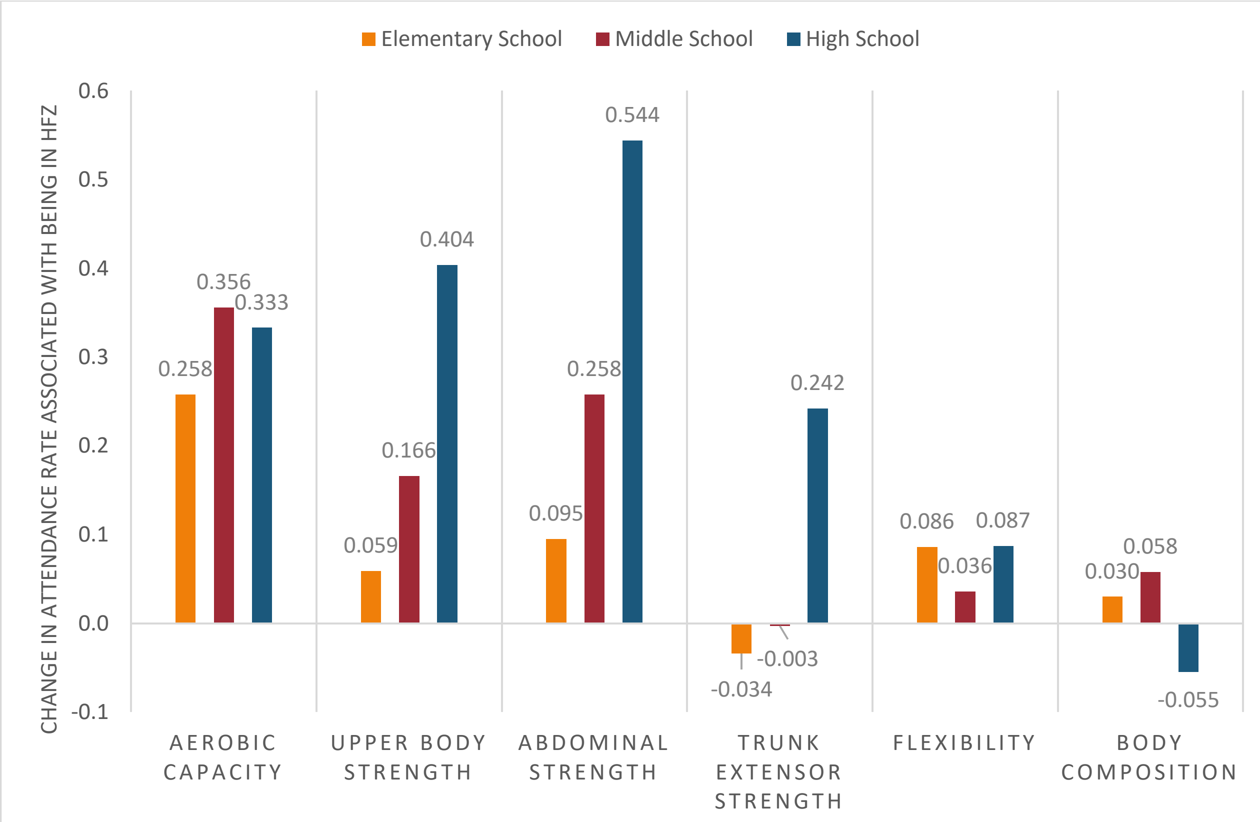


Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: A total of 257,352 male elementary school students, 211,378 male middle school students, and 131,058 male high school students were included in the 2015–16 analyses. With the exception of Upper Body Strength in elementary and high school students, Trunk Extensor Strength in elementary school students, Flexibility in middle and high school students, and Body Composition in middle school students, all relationships were statistically significant at the .05 level or better.

For female students in high school who met 2014–15 HFZ thresholds for Abdominal Strength (+0.54 percentage points), Upper Body Strength (+0.40 percentage points), and Trunk Extensor Strength (+0.24 percentage points), the association with the attendance rate was more consequential compared to female students in elementary and middle school. The relationship between female students meeting the threshold for being in the HFZ for Body Composition in 2014–15 and attendance rate was not meaningful regardless of the school's level (Figure 3.19).

Figure 3.19. – Multivariate Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2014–15, Female Students by School Level



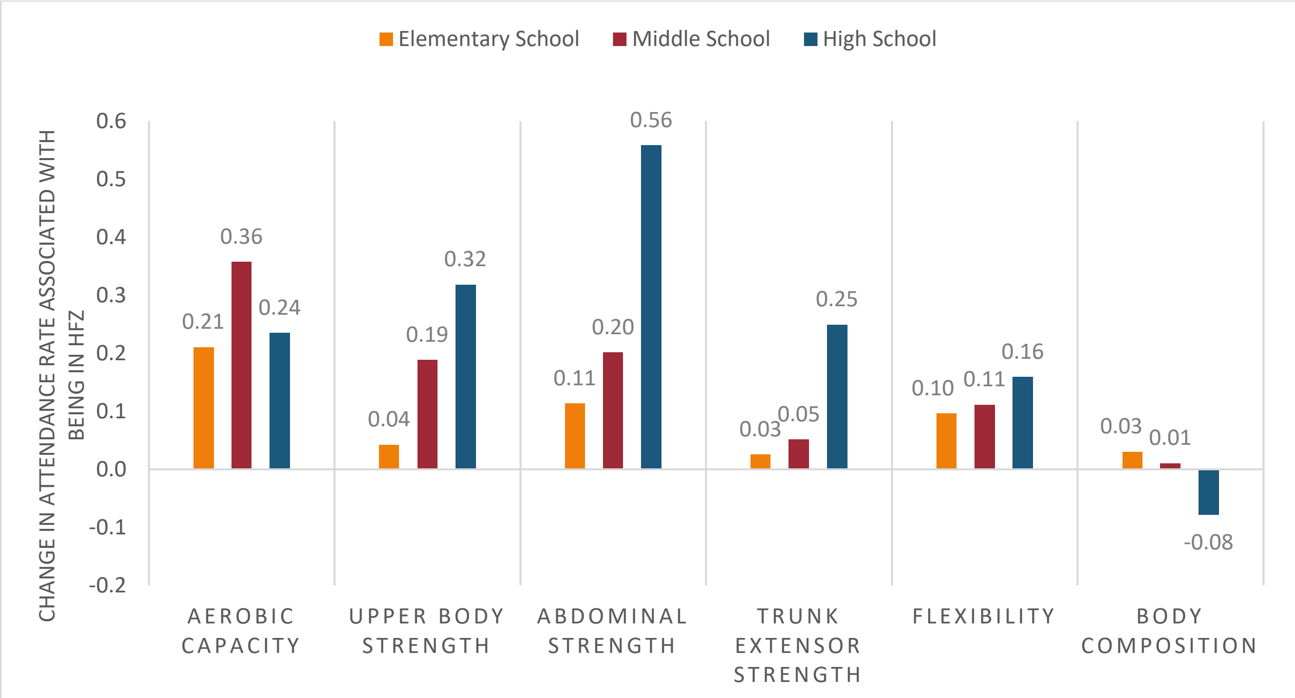
Source: FitnessGram® data, 2014–15; Public Education Information Management System, 2013–14 and 2014–15, Texas Education Agency.

Note: A total of 181,408 female elementary school students, 136,963 female middle school students, and 60,387 female high school students were included in the 2014–15 analyses. With the exception of Trunk Extensor Strength in students at all three school levels, Flexibility in middle and high school students, and Body Composition in high school students, all relationships were statistically significant at the .05 level or better.

As Figure 3.20 illustrates, similar results were observed for female students in 2015–16, where the associations between HFZ status and school attendance rate was largest for high school students for the Abdominal Strength, Upper Body Strength, and Trunk Extensor Strength measures when compared to their elementary and middle school peers.

In contrast, the difference for being in the Aerobic Capacity HFZ was larger for middle school female students (+0.36 percentage points) than elementary and high school female students.

Figure 3.20. – Multivariate Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2015–16, Female Students by School Level



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

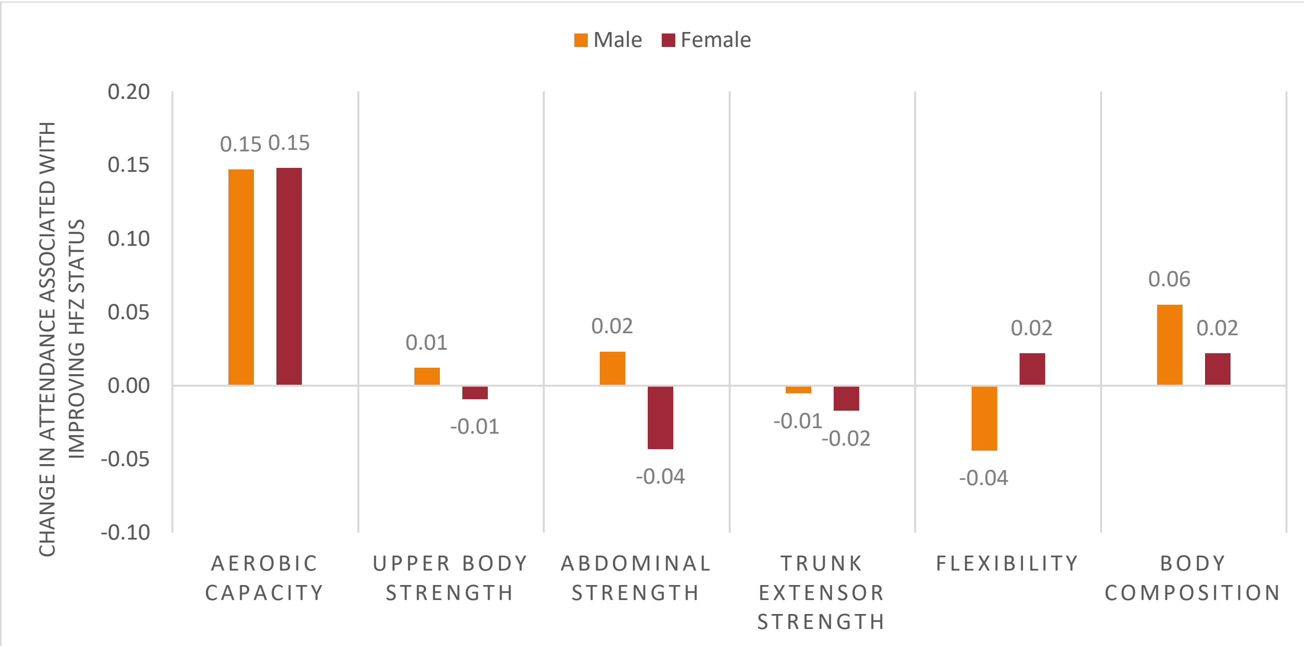
Note: A total of 245,127 female elementary school students, 200,238 female middle school students, and 109,243 female high school students were included in the 2015–16 analyses. With the exception of Trunk Extensor Strength in students at all three school levels and Body Composition in middle and high school students, all relationships were statistically significant at the .05 level or better.

Association of Changes in Fitness Levels Between 2014–15 and 2015–16 and Attendance Rate

Similar to the outcomes analyses presented for Research Question 3.1 in this chapter, the evaluation team also explored the relationship between improved fitness from one year (2014–15) to the next (2015–16) and attendance rate for male and female students.

As Figure 3.21 shows, the relationship is quite weak with small differences across all six fitness measures. The largest association for both male and female students was found between attaining the Aerobic Capacity HFZ and regular school day attendance rate. For both males and female students, being in this HFZ was associated with 0.15 percentage point increases in regular school day attendance rate.

Figure 3.21. – Multivariate Results Between Changes in FitnessGram® HFZ Attainment Between 2014–15 and 2015–16 and Male and Female Student Attendance Rate



Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

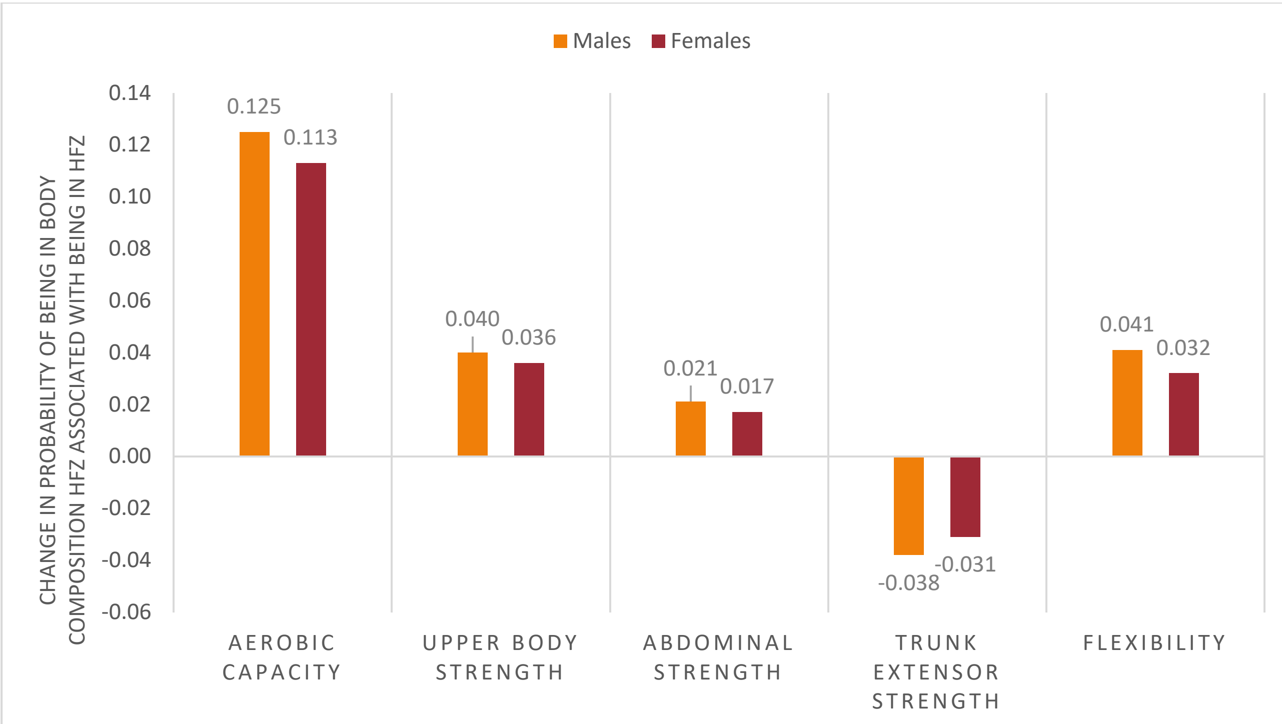
Note: A total of 253,972 male students and 239,162 female students were included in the analyses. With the exception of Aerobic Capacity for males and females and Body Composition for males, no relationships were statistically significant at the .05 level or better.

Research Question 3.3: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and student obesity?

FitnessGram® data include BMI and the percent body fat, either of which can be used to classify a student in the HFZ. BMI is recognized by the Centers for Disease Control and Prevention as a measure of childhood obesity. For children, BMI is used to screen for being obese, overweight, at a healthy weight, or underweight. The evaluation team used age and gender standardized Body Fat Percentage and BMI, and whether the student is in the Body Composition HFZ to analyze the relationship with the other fitness measures.

As Figure 3.22 illustrates, the average probability change for a male student in the Body Composition HFZ is +13 percentage points if they attain the Aerobic Capacity HFZ, and the average probability change for a female student in the Body Composition HFZ is +11 percentage points if they attain the Aerobic Capacity HFZ. The relationship is weaker for the other four measures of physical fitness, with the Trunk Extensor Strength measure showing a weak negative relationship attaining the Body Composition HFZ.

Figure 3.22. – Multivariate Results Between FitnessGram® HFZ Metrics and Body Composition HFZ Attainment by Gender, 2015–16



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

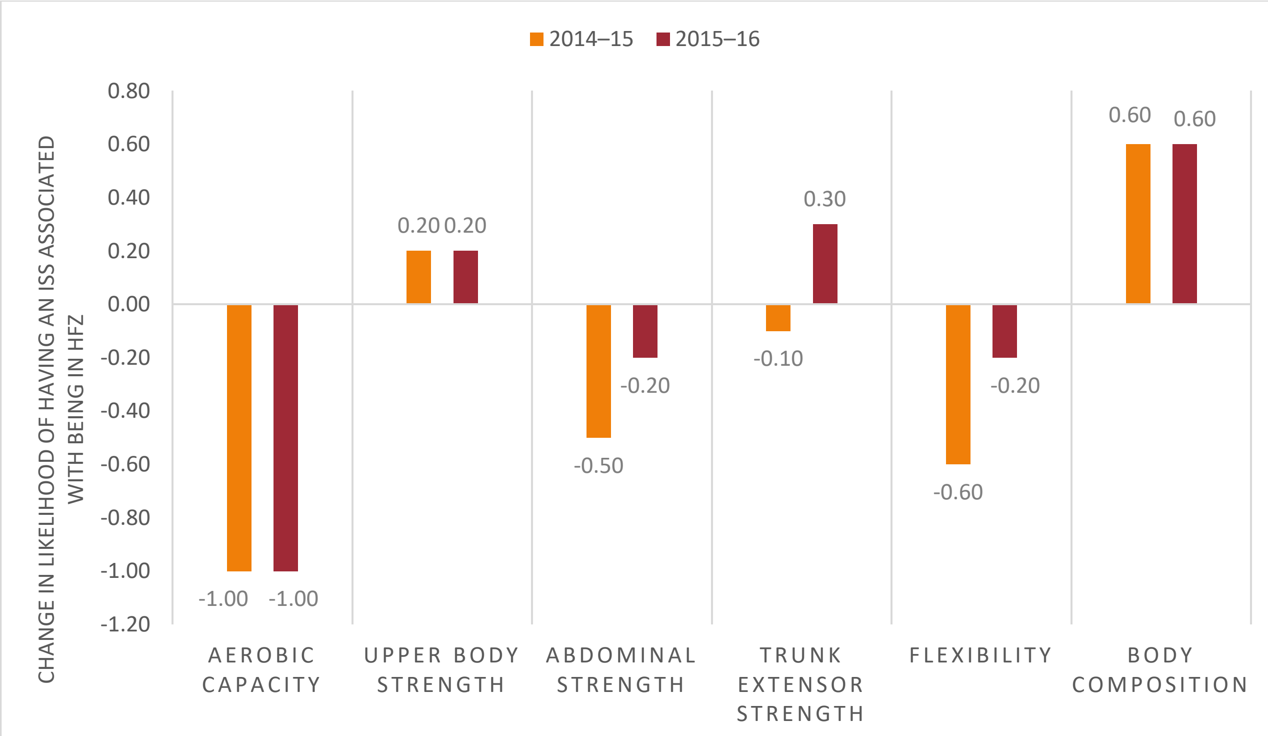
Note: This statistical model could only be run for 2015–16 because the lagged dependent variable for 2014–15 (i.e., 2013–14 Body Composition HFZ status) was not available. The model for male students included 533,179 students and the model for female students included 496,209 students. All relationships were statistically significant at the .05 level or better for males and females.

Research Question 3.4: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and student disciplinary problems?

Regarding disciplinary removals, administrators can choose from a range of options outlined in the student code of conduct. The evaluation team created a statistical model to examine the relationship between a student being in the HFZ for each of the six fitness measures and whether a student received an in-school or out-of-school suspension during each of the school years of interest (2014–15 and 2015–16).

The correlational findings from Chapter 2 of this report present low (e.g., weak) correlations between HFZ attainment and the number of ISS and OSS referrals. As Figure 3.23 shows, the relationship between HFZ attainment for male students is negative and strongest between Aerobic Capacity HFZ attainment and a percentage change in having an ISS referral. Male students in the HFZ were less likely to receive an ISS referral in 2014–15 and 2015–16 by one percentage point. No other coeficients representing the associations between other HFZ achievement measures rise above six-tenths of one percentage point.

Figure 3.23. – Multivariate Results Between FitnessGram® HFZ Metrics and ISS Referrals, 2014–15 and 2015–16, Male Students

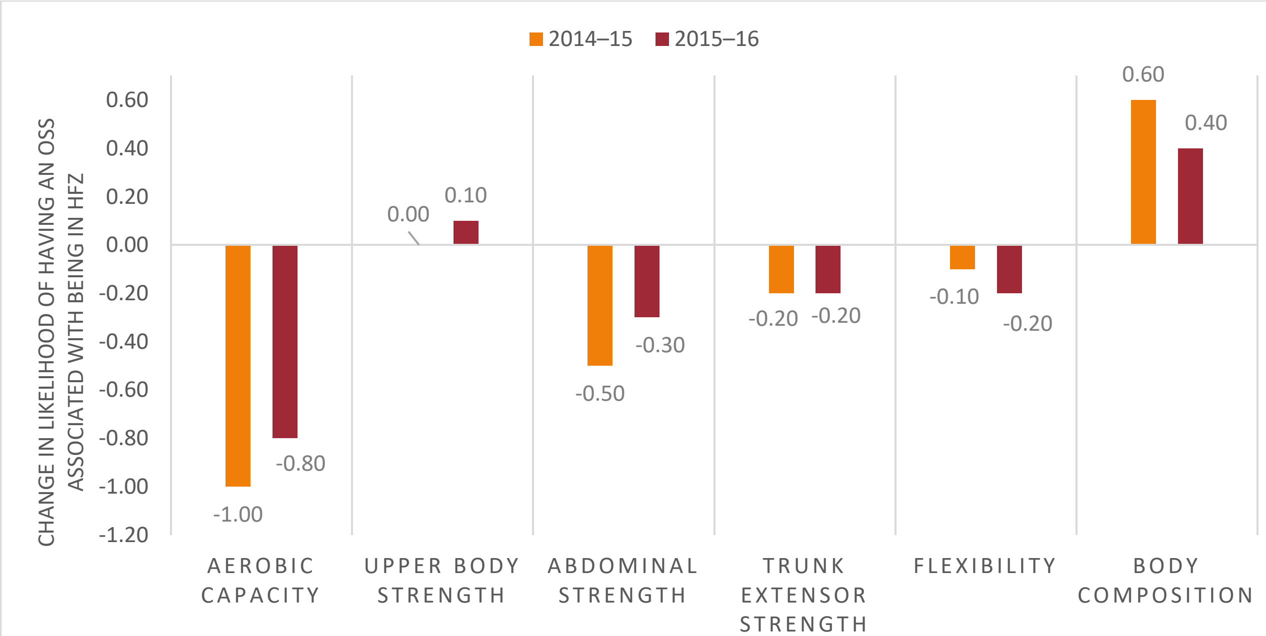


Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 489,676 male students were included in the 2014–15 analyses and 641,961 male students were included in the 2015–16 analyses. With the exception of Upper Body Strength in 2014–15 and 2015–16, Abdominal Strength in 2015–16, Trunk Extensor Strength in 2014—15 and 2015–16, and Flexibility in 2015–16, all relationships were statistically significant at the .05 level or better.

The relationship between FitnessGram® HFZ attainment and the more severe OSS referral was comparable to that observed for ISS referrals presented in Figure 3.23 with Aerobic Capacity HFZ attainment having the largest association with having an OSS referral. Male students in the HFZ were less likely to receive an OSS referral in 2014–15 by 1.0 percentage point and by 0.8 percentage points in 2015–16 (Figure 3.24).

Figure 3.24. – Multivariate Results Between FitnessGram® HFZ Metrics and OSS Referrals, 2014–15 and 2015–16, Male Students

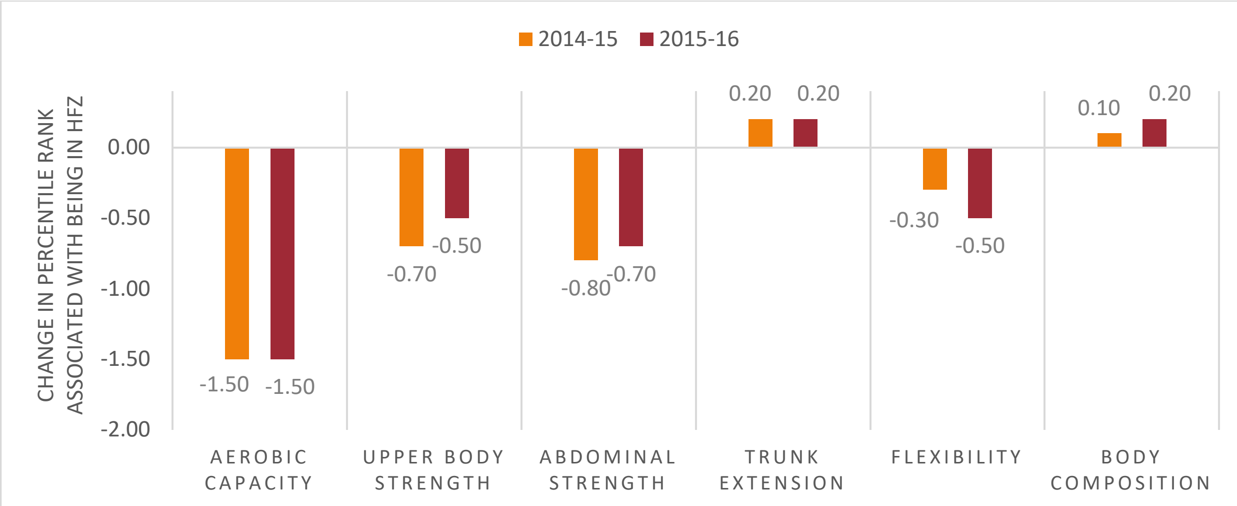


Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 489,676 male students were included in the 2014–15 analyses and 641,961 male students were included in the 2015–16 analyses. With the exception of Upper Body Strength in 2014–15 and 2015–16, Trunk Extensor Strength in 2014—15 and 2015–16, and Flexibility in 2014—15 and 2015–16, all relationships were statistically significant at the .05 level or better.

The results for the relationship between female students meeting the HFZ threshold and ISS and OSS referrals mirrors those presented above for male students, with Aerobic Capacity HFZ attainment having the largest (negative) coefficient. As Figure 3.25 shows, a female student in the Aerobic Capacity HFZ was was estimated to have a 1.5 percentage point decrease in the likelihood having an ISS referral in both 2014–15 and 2015–16. This FitnessGram® measure had the strongest association with the likelihood of having an ISS referral.

Figure 3.25. – Multivariate Results Between FitnessGram® HFZ Metrics and ISS Referrals, 2014–15 and 2015–16, Female Students

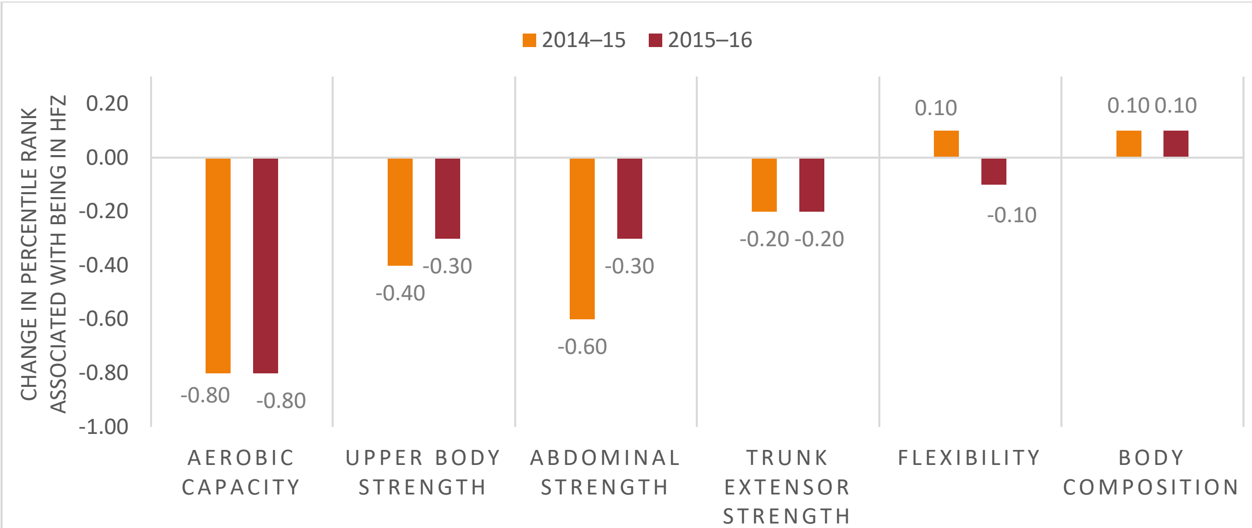


Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 460,105 female students were included in the 2014–15 analyses and 596,432 female students were included in the 2015–16 analyses. With the exception of Trunk Extensor Strength in 2014—15 and 2015–16 and Body Composition in 2014–15 and 2015–16, all relationships were statistically significant at the .05 level or better.

When examining the relationship between HFZ achievement on the various fitness measures and the more serious OSS referral, again, the Aerobic Capacity HFZ was most strongly associated with a decreased likelihood of receiving an OSS referral. Like the ISS results, for a female student, attaining the Aerobic Capacity HFZ was associated with a 0.8 percentage point decrease in the likelihood of having an OSS referral in 2014–15 and 2015–16. For a female student, attaining the Abdominal Strength HFZ was associated with a 0.6 percentage point decrease in the likelihood having an OSS referral in 2014–15 and a 0.3 percentage point decrease in 2015–16 (Figure 3.26).

Figure 3.26. – Multivariate Results Between FitnessGram® HFZ Metrics and OSS Referrals, 2014–15 and 2015–16, Female Students



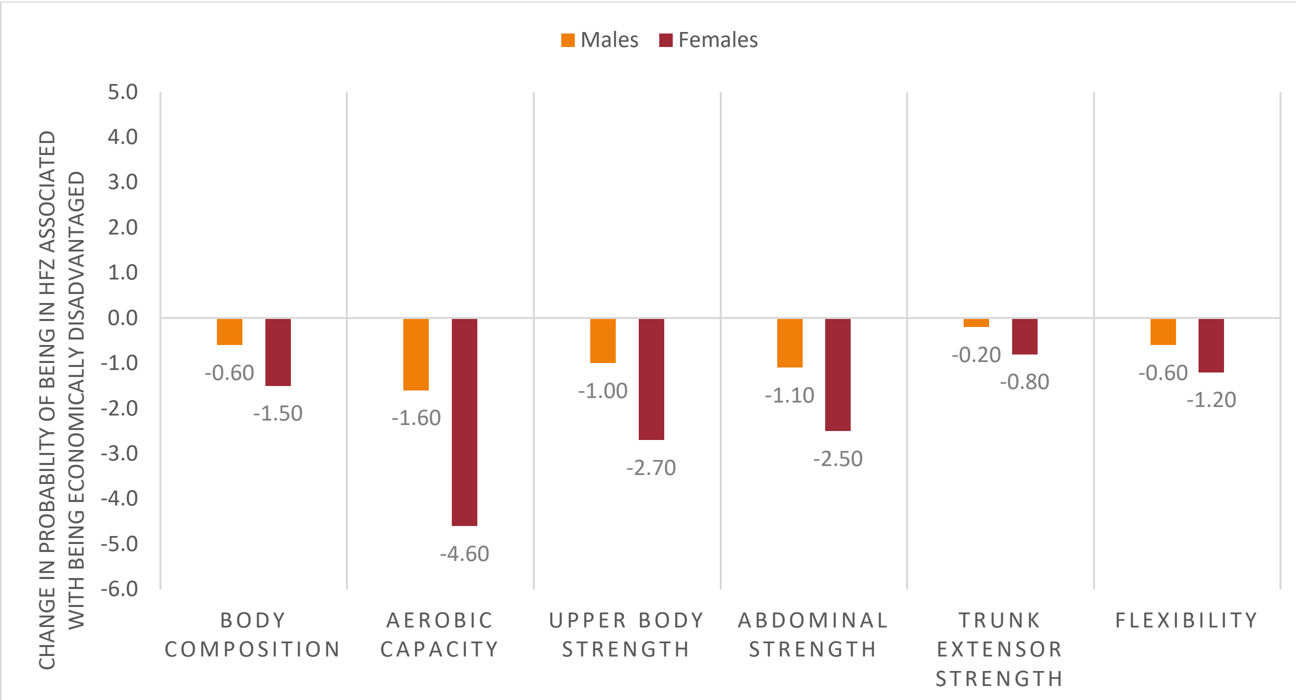
Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

Note: A total of 460,105 female students were included in the 2014–15 analyses and 596,432 female students were included in the 2015–16 analyses. With the exception of Trunk Extensor Strength in 2014—15 and 2015–16 and Flexibility in 2014–15 and 2015–16, all relationships were statistically significant at the .05 level or better.

Research Question 3.5: After controlling for demographic, academic, and non-academic differences between students, what is the relationship between HFZ attainment and participation in school meal programs?

PEIMS data include economically disadvantaged codes for students, including indicators of students' eligibility for free or reduced price meals (FRPL) under the National School Lunch and Child Nutrition Program. Table 2.8 provides data which examines the correlational relationship between key physical fitness metrics and participation in the FRPL program. As Figure 3.27 shows, economically disadvantaged status is negatively associated with the likelihood of meeting the threshold for the HFZ for all of the FitnessGram® measures. However, the largest association for both male and female students was in the Aerobic Capacity HFZ where economic disadvantaged status was associated with a decreased likelihood of males attaining in the HFZ for this measure (1.6 percentage points) and of females by 4.6 percentage points. For the fitness measures examined in this analysis, the estimated effect was larger for female students than male students.

Figure 3.27. – Multivariate Results Between Economically Disadvantaged Status and FitnessGram® HFZ Metrics by Gender, 2015–16



Source: FitnessGram® data, 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Note: This statistical model could only be run for 2015–16 because the lagged dependent variable for 2014–15 FitnessGram® HFZ status (e.g., 2013–14 Body Composition HFZ, Aerobic HFZ, and other fitness measures) was not available for analysis. The model for male and female students included the following number of students by model dependent variable: Body Composition, 607,808 male students and 563,184 female students; Aerobic Capacity, 316,600 male students and 233,343 female students; Upper Body Strength, 615,362 male students and 570,410 female students; Abdominal Strength, 634,057 male students and 586,246 female students; Trunk Extensor Strength 604,208 male students and 561,432 female students; and Flexibility, 627,551 amle students and 582,643 female students. With the exception of Trunk Extensor Strength for male students, all relationships explored in the analyses were statistically significant at the .001 level.

Summary of Multivariate Results

Research findings from multivariate regression analyses presented in this chapter are consistent with the correlational results presented in Chapter 2 in that student attainment of FitnessGram® HFZs was associated with better academic, attendance, and disciplinary outcomes than students who did not meet the HFZ threshold. Higher fitness levels were associated with higher percentile rankings of the STAAR mathematics and reading exams, higher regular school day attendance rates, and a lower likelihood of having an ISS or OSS referral. The relationship between physical fitness and student outcomes was consistently stronger for the Aerobic Capacity and Abdominal Strength metrics than the other FitnessGram® measures for both 2014–15 and 2015–16.

The magnitude of the effect of being in a HFZ was also larger in 2014–15 than it was in 2015–16 and more meaningful for male students than it was for female students. When results for academic and attendance outcomes were disaggregated by school level, interesting differences emerged. High school students attaining a HFZ (for several metrics) had a larger effect on STAAR mathematics and STAAR reading percentile rankings and on regular school day attendance rate than it did for middle school and elementary school students. This was particularly evident in the Aerobic Capacity and Abdominal Strength measures.

Appendix A – Physical Fitness Assessment Initiative (PFAI) and FitnessGram® Data

Districts are required to submit district, campus, grade, and gender disaggregated fitness information to TEA for reporting and are allowed to do so one of two ways. The first is to use the Physical Fitness Assessment Initiative (PFAI) aggregate reporting tool, and the second is to submit student level data via FitnessGram® which is then aggregated and combined for reporting. This appendix first describes the PFAI reporting tool data and the FitnessGram® data. Next, it documents the procedure for aggregating the FitnessGram® data and combining it with the PFAI reporting tool data to produce the spreadsheets published by TEA:

http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data/.

PFAI Reporting Tool Data

Submissions from districts using PFAI for 2014–15 and 2015–16 contain grade and gender-level fitness data for 221 campuses from 64 districts in 2014–15 and 295 campuses from 26 districts in 2015–16. For each of the fitness tests, this dataset contains counts of the number of students tested and the number of students who are in the HFZ by campus, grade, and gender. In addition to the percentage of students in the HFZ, some measures also include the number and percentage of students at some-risk and at high-risk. Table A1 shows which fitness measures contain those counts and percentages in addition to the HFZ counts and percentages. The table separators show how each fitness assessment is related to the six main fitness measures. In the PFAI tables, there are also counts of how many of the six HFZs students achieved. However, there are not variables for each of the HFZs when more than one test can be taken to assess fitness. This is the case for Aerobic Capacity, in which students can achieve the HFZ by taking the one-mile run, PACER, or walk tests. Put differently, while Aerobic Capacity is one of the HFZs included in the count of HFZs, there is no variable for the aerobic fitness HFZ which classifies students as in the HFZ regardless of which test they took.

Table A-1. Fitness Measures Included in the PFAI Reporting Tool

Fitness Indicator	Students Tested	Students in HFZ	Percent in HFZ	Students at Some-Risk	Percent at Some-Risk	Students at High-Risk	Percent at High-Risk
HFZ Count Measures							
No categories in HFZ	X	X	X				
At least one in HFZ	X	X	X				
One in HFZ	X	X	X				
Two in HFZ	X	X	X				
Three in HFZ	X	X	X				
Four in HFZ	X	X	X				
Five in HFZ	X	X	X				
Six in HFZ	X	X	X				
Aerobic Capacity							

Fitness Indicator	Students Tested	Students in HFZ	Percent in HFZ	Students at Some-Risk	Percent at Some-Risk	Students at High-Risk	Percent at High-Risk
Mile	X	X	X	X	X	X	X
PACER	X	X	X	X	X	X	X
Walk test	X	X	X				
Body Composition							
Percentage Body Fat	X	X	X	X	X	X	X
Body Mass Index	X	X	X	X	X	X	X
Abdominal Strength and Endurance							
Curl-up	X	X	X				
Upper Body Strength and Endurance							
Flexed Arm Hang	X	X	X				
Push Up	X	X	X				
Modified Pull Up	X	X	X				
Flexibility							
Shoulder Stretch	X	X	X				
Sit and Reach	X	X	X				
Trunk Extensor Strength							
Trunk Extensor Strength	X	X	X				

Source: Physical Fitness Assessment Initiative, 2014–15 and 2015–16, Texas Education Agency.

In addition to the various fitness measures, grade, gender, school identifiers, and district identifiers, the PFAI reporting tool data contains several other variables that are shown in Table A2.

Table A-2. Other PFAI Reporting Tool Variables (by Campus, Grade, and Gender)

Variable	Description
Enrollment count	Number of students enrolled
Days of attendance	Days attended
Days of membership	Days enrolled
Attendance rate	Days of attendance divided by days of membership
Economic disadvantage code 1	Number of students eligible for free meals
Economic disadvantage code 2	Number of students eligible for reduced-price meals

Variable	Description
Economic disadvantage code 99	Other economic disadvantage
Substance abuse occurrence count	Number of substance abuse instances
Substance abuse student count	Number of students with substance abuse instances

Source: Physical Fitness Assessment Initiative, 2014–15 and 2015–16, Texas Education Agency

FitnessGram® Data

Unlike the data from the PFAI reporting tool, the FitnessGram® data are available at the student-level as opposed to being aggregated to the gender-grade-campus-level. Since the data contain private information about students, they can only be accessed at one of the Education Research Centers (ERCs), and all output taken from the analysis must be approved to maintain students' privacy and meet Family Educational Rights and Privacy Act (FERPA) regulations. Gibson accessed this data at the ERC at the University of Texas at Austin (UT-ERC).

The research team accessed the individual level fitness data in order to aggregate data to the district, campus, grade, and gender level and then combine it with the PFAI data. Several variables in the PFAI reporting tool are not present in the FitnessGram® data, which include attendance, economic disadvantaged, and substance abuse variables, which are listed in Table 3. These data were obtained by linking each student's FitnessGram® data to Public Education Information Management System (PEIMS) records. In 2014–15, a total of 1,183 school districts encompassing 7,747 campuses had student level FitnessGram® records that were able to be linked to TEA administrative records for analysis (or about 97.1% of all districts and 93.4% of all campuses had FitnessGram® records). In 2015-16 there were linkable records for students in 1,181 school districts representing for 7,787 campuses (or about 97.8% of districts and 93.7% of campuses).

Data Processing and Combination

After combining the student-level data from FitnessGram® and PEIMS[23], two notable issues emerged when working with the FitnessGram® data. First was that the FitnessGram® data did not include individual test HFZ information for the Aerobic Capacity tests (mile walk test, mile run test, and PACER) as is reported in the PFAI reporting tool data. The results were derived from raw data, but could not be done precisely, since the PACER equation for the calculation of HFZ scores is proprietary. However, the rules for the mile walk and mile run test are not, and VO_2 max values used for classifying students can be independently calculated. Therefore, the following rules were used to ascertain whether students who had achieved the aerobic capacity HFZ did so via the walk test, the mile run test, or PACER.

[23] See Appendix B for a detailed account of this process

1. First the research team recalculated the VO_2 max scores from mile run test and mile walk information. If the recalculated figure matched the VO_2 max value reported by FitnessGram® students were coded as having passed that test.
2. Students who are classified in the aerobic capacity HFZ, but whose VO_2 max scores do not match the recalculated $V0_2$ max from the mile walk or mile run test, and have a PACER lap count are coded as having taken the PACER assessment.
3. If Aerobic Capacity codes are test specific (some apply only to each test[24]) students are classified as having taken that test.
4. If none determine which test was taken, and students have information pertaining to multiple tests, students are classified as having taken the PACER, then the mile run, then the walk test[25] if they have information on those tests[26].

The second notable issue was that the ERC's masking rules are more stringent than those used in the PFAI reporting in the past. Previous PFAI reporting merely masked all rows with fewer than five students in a district-campus-grade-gender. However, ERC rules require masking for *any cell* with fewer than five students. For example, if six students were recorded in a campus/grade/gender, three of them were in the Aerobic Capacity HFZ, and three were not, those cells would need to be masked by ERC rules. However, this level of masking had not been conducted in prior output. ERC rules also require top and bottom coding for cells which are 100% or 0% (or close to it depending on the total number of students) with complementary cell masking to prevent backwards solving of the masked cells. Reporting the PFAI tables in the same way as had been done previously would have resulted in the masking of the majority of cells. Therefore, the research team devised a method to allow for the export of more information while still following ERC masking rules. Changes from prior reporting are outlined below:

1. All fitness counts except the overall number of students tested were eliminated.
2. Counts of students tested, and students with free or reduced-price lunches were aggregated to the campus level to create more populous cells which would not be masked as often.
3. With counts eliminated, percentages for campus-grade-gender could now be presented more frequently, but required top/bottom coding for any cells within a certain range[27] of 0% and 100%

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[24] For example, code 14 is for under a four minute mile run.

[25] This order is used because PACER is most common overall, followed by mile run, followed by mile walk.

[26] This is to say that a student that had information on PACER and mile run would be classified as PACER. A student who had information on mile run and walk would be classified as mile run test.

[27] The size of the range depended on the total number of students.

   a. The cells were masked as >90% or <10%[28].

4. Complementary cell values were changed slightly and truncated[29] and then masked with an ≈ sign to prevent backwards solving.

The changes allowed for the most possible information to be included in the table. The summary statistics were submitted for approval to remove from the ERC and combined with the PFAI reporting tool data (which was modified to be consistent with the FitnessGram® derived data).

[28] Rows with more students could use the >95%, >99%, <5%, and <1% masking

[29] Complementary cells are those that could be used to backwards solve a masked cell. For example, consider a grade in which 90% of male students were in the Aerobic Capacity HFZ, 8% were at some risk, and 2% were at high risk. The 2% would have to be masked as <5%, however, if the 8% and 90% cells were unmasked, one could solve the percentage of students in the masked cell (100%-90%-8%=2%).

Appendix B – Methodological Detail

This appendix provides additional technical detail regarding the procedures used for data cleaning and management, the bivariate analyses, and the multivariate analyses. First, the data cleaning and preparation is described. Second, the bivariate analysis methodology is described. Lastly, the multivariate analysis methodology is described.

Data Cleaning and Preparation

Researchers at Gibson used data housed at the Education Research Center (ERC) at the University of Texas (UT) combined with FitnessGram® data provided to the ERC by TEA to produce the analyses for this project. This section describes the raw data used in the study,, describes data management, and cleaning to create the analytic dataset. Third, it examines how students with FitnessGram® records compare to all students with PEIMS records.

Data Tables

Table B1 shows the files that were accessible after review and conversion of the files housed at the ERC. The only files from the proposal/analysis plan that were unavailable from the ERC were the 2013-14 FitnessGram® data and the end-of-course exam data for English III, Algebra II, and Geometry. The FitnessGram® data used for this analysis are listed and defined in Table 1.1. All data elements were provided at the student-level and school-level percentages or rates were calculated using the students enrolled at each school or in each grade level.

Table B.1. – Data Elements Accessed at the UT ERC, by School Year and Source

Source	Tables	Selected Elements	Years
PEIMS	p_attend_demog(yy), p_attend_student(yy), p_enroll_demog	Unique student ID	2013–14, 2014–15, and 2015–16
		Grade level	
		Sex	
		Age	
		Number of days enrolled	
		Economically disadvantaged status (student's economic disadvantage status. Student eligible for free or reduced price meals (code ‘01’ and ‘02’) and students with ‘other economic disadvantage (code ‘99’) were coded as economically disadvantaged)	

Source	Tables	Selected Elements	Years
		Race/ethnicity	
		Campus ID of enrollment	
		District ID of enrollment	
		Limited English proficient status (whether the student has been identified as limited English proficient by the Language Proficiency Assessment Committee (LPAC), or English proficient (19 TAC §89.1220), according to criteria established in 19 TAC §89.1225)	
		Special education status (whether the student is participating in a special education instructional and related services program or a general education program using special education support services, supplementary aids, or other special arrangements. (See 34 CFR §300.13 and 19 TAC §§89.1060 and 89.1090)	
		Number of days absent	
		Number of days attended	
	P_stud_disc_act(yy)	Disciplinary Action Number	2013–14, 2014–15, and 2015–16
		Disciplinary Action Code	
		Disciplinary Action Reason Code	
		Disciplinary Incident Number	
		Campus ID of Enrollment	
	p_district(yy), p_campus(yy) (not available, but we are	Campus name	2013–14, 2014–15, and 2015–16
		District name	
		Region name	

Source	Tables	Selected Elements	Years
	creating this using individual data)	Campus grade enrollment span	
		District grade enrollment span	
		Campus type	
Testing	STAAR scale score	STAAR reading scale score	2013–14, 2014–15, and 2015–16
		STAAR mathematics scale score	
		English I and II End-of-Course Scale Scores (English 3 **missing**)	
		Algebra I End-of-Course Scale Scores (Algebra 2 and geometry **missing**)	
Unknown	FitnessGram® data	Aerobic Capacity	2014–15 and 2015–16 (2013–14 **not** available)
		Upper Body Muscular Strength and Endurance	
		Abdominal Muscular Strength and Endurance	
		Trunk Extensor Muscular Strength and Endurance	
		Flexibility	
		Body Composition	
		Student obesity	
		Body Mass Index (BMI)	
		Curl up	
		Flexed arm hang	
		Mile run	
		Modified pull up	
		PACER	

Source	Tables	Selected Elements	Years
		Percent body fat	
		Push up	
		Shoulder stretch	
		Sit and reach	
		Trunk lift	
		Walk test	

Source: FitnessGram® data, 2014–15 and 2015–16, Public Education Information Management System, 2013–14, 2014–15, and 2015–16, Texas Education Agency.

Data Management and Cleaning

The data were cleaned and combined with the goal of creating a final analytic dataset with one record per student-year. The TEA PEIMS data include all students in the 2013-14, 2014–15, and 2015–16 school years for grades 3 through 12 based on students with valid IDs in the TEA PEIMS demographic and enrollment files. This subsection describes the procedure from reducing observations to one observation per student per year for each of the data sources (PEIMS, STAAR/EOC, and FitnessGram®), and the resulting combination of the tables.

PEIMS Inclusion Rules

A number of TEA PEIMS student records contained duplicate observations of the same student. The following business rules were used to select which duplicate observation was retained for subsequent analyses. The rules below were applied in order; if tied on one rule, the rule below it was applied.

1. The observation with the most recent enrollment date (by school year)
2. The observation with missing values for the fewest variables.
3. An observation selected at random among remaining duplicates.

An exception to this procedure was the discipline tables. For these, multiple records for a student within a year represented multiple incidents rather than duplicate records. Therefore, rather than eliminating duplicate observations, count variables were generated which recorded the number of incidents a student had of various types (i.e. ISS, OSS) within a year.[30] Students

[30] Students coded as having an ISS incident are those incidents with disciplinary action codes 6 and 26, and those coded as having an OSS incident are disciplinary action codes 5 and 25

with no matched disciplinary records were coded as having zero for all discipline measures, as it was assumed they did not have reported disciplinary records[31].

The files were merged together into one PEIMS dataset. This process yielded 5,211,622 records in 2014–15 and 5,282,792 records for 2015–16, a match rate of over 99%.

STAAR/EOC Inclusion Rules

The STAAR/EOC data contained 92 files (about 2.4G of data) with 26 variables and 13.2 million records (approximately 7 million unique/unduplicated student-year records). Only the mathematics, reading, Algebra I, English I, and English II tests were considered for the analysis, so those variables, and observations which contained values for those variables, were retained from each of the test files and combined into one file. The records were then reduced to one record per student per year using the following business rules.

1. The first administration of a test in a year was retained.
2. Algebra I is prioritized over a STAAR mathematics score if the student took both exams in the same year.
3. English II is prioritized over English I and STAAR reading scores if the student took both exams in the same year.
4. An observation was selected at random among remaining duplicates.

FitnessGram® Inclusion Rules

After combining all grades and years into a single dataset, the research team condensed the records into one observation per student per year. For these records, it was often necessary to combine information from multiple records for a student in order to obtain as complete of information as possible about the student's fitness. If a student took two assessments on a particular day and then another on a different day, these would often be represented in two different records. Therefore, the following process was used to condense observations to one per student per year.

1. The most recent observation is kept for use.
2. If a variable in the most recent observation is missing, it was filled in from the next most recent, non-missing, observation.
3. If there is more than one observation on the next most recent day, the observation with fewer missing values was used first.
4. Incomplete scores (codes five through eight) were replaced with earlier completed scores; the exempt score (code 11) was not.

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[31] There is no way to discern between a student record which might not properly match to discipline records and one with no disciplinary records.

5. Codes that represent unreasonable values (such as a two-minute mile, codes 12-14) were replaced with earlier, reasonable scores.

Following this procedure, records were reduced to one per student per year; Table B2 shows the counts of records before and after this process.

Table B.2. – FitnessGram® Duplicate Records, 2014–15 and 2015–16

Year	Initial Number of Observations	One Observation per Student-Year	Number of Duplicate Observations	Percent of Duplicate Observations	Students in Analytic Dataset
2014–15	2,558,620	2,183,130	375,490	14.68%	2,163,000
2015–16	2,778,008	2,104,971	673,037	24.23%	1,880,701

Source: FitnessGram® data, 2014–15 and 2015–16, Texas Education Agency.

One should note that prior to the reduction of cases to one record per student per year, 2015–16 had considerably more observations than 2014–15; however, following this operation, the number of cases are more similar since many of the surplus FitnessGram® cases in 2015–16 were incomplete records or duplicates. The usage of the incomplete codes increased drastically in 2015–16, often such that students had no values recorded aside from those incomplete scores[32]. This further reduced the number of students included in the 2015–16 analysis. Significant changes in the data generating process (e.g., changes in the software or data uploading mechanisms which would capture partial or incomplete metrics in one year but remove them in another year) could influence regression coefficients, fit statistics, and other inferences gathered from the data. In other words, the changes could structure differences between the years which may not be reflective of the true relationships between fitness and academic and non-academic outcomes.

Following the preparation of each set of tables (FitnessGram®, STAAR, and PEIMS), they were combined into a single file suitable for analysis. Table B3 shows the counts of students with PEIMS and STAAR records and counts of students in the analytic dataset split by year.

[32] Records without any valid fitness assessments were excluded from the analytic dataset, which accounts for the difference between the one observation per student-year and students in analytics dataset columns, along with a small number of records that could not be matched to TEA records.

Table B.3. – Percent of Students Included, 2014–15 and 2015–16

Year	STAAR and PEIMS	Analytic Set	Percent of students included
2014–15	3,779,231	2,163,000	57.23%
2015–16	3,858,012	1,880,701	48.75%

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2013–14, 2014–15 and 2015–16, Texas Education Agency.

Comparison Between Students with FitnessGram® Records and all PEIMS Records

This section considers how changes in the types of students and schools that participate in FitnessGram® in any given year can impact observed changes in the outcomes and patterns we reported in our analyses. About half of all students in Texas have FitnessGram® records; however, FitnessGram® is not equally distributed across all grade levels, school or district types, or student sub-groups. We suspect that differences in FitnessGram® could be linked to several factors, including:

- **School opt-out.** Not all schools participate in FitnessGram® (nor PFAI) and the reasons for this participation are not captured by the data.
- **School level or grade level.** Students are usually assessed in physical education (PE) classes. While the classes are more common in elementary and middle school, high school students have other course options that may not be required to report to (or test using) FitnessGram®.
- **Student and school characteristics.** In addition to grade level, the types of students who take these PE courses may differ by student demographics (e.g., race/ethnicity, gender, special education status, student discipline placement status) and school or district demographics (e.g., school size or resources).
- **Unobserved characteristics.** Unobserved factors such as students' sensitivity to test-taking across time, differences in FitnessGram® training/professional development for the PE instructor (or FitnessGram® administrator), differences in data entry timeliness and accuracy (e.g., recall that there were a higher number of incomplete and duplicate entries in 2015-16 than 2014-15).

In order to assess whether the data analyzed in this report are reflective of the student population of Texas, and to better understand how FitnessGram® participants might be different from the population of all students or differ across academic school years for some of the reasons mentioned above, we make comparisons based on student and school demographics in this section.

Table B.4. shows the mean and standard deviation of academic and non-academic factors for those students with FitnessGram® records (the "sample") and all students. This table shows that, even though the number of students taking FitnessGram® and the distribution of FitnessGram® participation across schools changed between the years, the sample in both years is similar in distribution to all students with records and that the mean values and standard deviations for both years are similar in the sample and student population. The most notable difference in the table is that the standard deviation of percent attendance is noticeably lower for the sample than for all students for both years. Since the mean is also slightly lower, this suggests that students who attend fewer days are less likely to have FitnessGram® records.

Table B.4. – Academic and Non-Academic Outcomes in Sample and Population, 2014–15 and 2015–16

	Mean				Standard Deviation			
Outcome	2014–15		2015–16		2014–15		2015–16	
	Sample	All Students	Sample	All Students	Sample	All Students	Sample	All Students
Reading percentile	51.43	50.67	51.56	50.66	28.65	28.84	28.54	28.84
Mathematics percentile	51.59	50.67	51.69	50.66	28.70	28.84	28.66	28.85
Percent attendance	96.34	95.51	96.54	95.55	4.40	6.29	4.19	6.56
Body Composition HFZ	0.62	0.62	0.62	0.62	0.49	0.49	0.49	0.49
ISS count	0.26	0.30	0.24	0.28	1.12	1.22	1.06	1.16
OSS count	0.09	0.11	0.08	0.11	0.58	0.68	0.53	0.65

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table B.5. presents the percent of students in the sample and for all records with the demographic features of interest. Most of the demographic characteristics are similar for those with FitnessGram® compared with all students. The only difference of more than a percentage point is that there are a slightly higher proportion of students with special education status in the sample than in the population (about two percentage points in 2014–15 and about one percentage point in 2015–16).

Table B.5. – Demographic Characteristics in Sample and Population, 2014–15 and 2015–16

	Percent of Students			
Student Demographic	2014–15		2015–16	
	Sample	All Students	Sample	All Students
Female	48.1%	48.8%	48.2%	48.8%
Economically Disadvantaged	56.7%	56.2%	56.6%	56.6%
Special Education	8.4%	9.1%	8.5%	9.1%
English language Llearner	16.6%	14.1%	16.5%	14.7%
Asian	4.0%	3.9%	4.1%	4.1%
Black	11.9%	12.6%	11.5%	12.6%
Hispanic	51.7%	51.0%	51.7%	51.5%
American Indian or Alaskan Native	0.4%	0.4%	0.4%	0.4%
Pacific Islander	0.1%	0.1%	0.1%	0.1%
Two or More	2.0%	1.9%	2.1%	2.0%
White	30.0%	30.0%	30.1%	29.4%

Source: Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table B.6. shows the percent of students and campuses that are present in both study years, separated by school level[33]. Just as the proportion of students assessed with FitnessGram® decreased across grade levels, the proportion of students with records in both study years is smaller for middle and high schools than for elementary schools. This means that fewer students were included in models which consider change between years (since these students

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[33] Note that the campuses included are based on TEA records matched by student ID, not the campus/district that is recorded in the FitnessGram® data as these were determined to be more reliable. A small proportion of cases are expected to mismatch depending on when the TEA record was generated compared to when the FitnessGram® assessment took place. Empirically, about 2.4% of the FitnessGram® recorded districts do not match to the TEA record for that student.

would be missing FitnessGram® records in one of the comparison years), and that results for high school students in particular are derived from information for fewer students.

There is nearly a 10 percentage point difference in elementary and middle schools that participate in FitnessGram® in one year and not the other, that proportion increases to over one-quarter for high schools. Some of these schools could be new, some could have closed down or been consolidated within the district, and others could have decided to opt-out of FitnessGram® for unmeasured reasons.

Table B.6. – Percent of Students and Campuses in Both 2014–15 and 2015–16

School type	School	Campuses
Elementary	54.50%	93.50%
Middle	40.60%	92.60%
High	11.20%	72.20%
Other	28.80%	72.10%

Source: FitnessGram® data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

What factors are associated with the propensity to participate in FitnessGram®? In order to understand how student and school demographics are associated with FitnessGram® and academic outcomes, we need to also consider the patterns in a temporally prior step in FitnessGram® participation; that is, in this section we analyze the factors that are associated with the propensity to participate in FitnessGram®. In doing so, several findings emerged:

- **School size and grade level were associated with changes in participation rates.** Any given student was more likely to participate if they were in the lower grade levels, particularly in 2014–15 (in comparison with 2015–16). Students in middle-sized schools and in middle-sized schools spanning kindergarten through grade 12 (that is K-12 schools and schools in the middle two quartiles of school size; between 339 and 1553 total students) were most likely to participate (adjusting for all else). Participation rates in elementary schools saw the largest decline in participation between 2014–15 and 2015–16 (nearly 9 percentage points).
- **School size was associated with participation rate differences.** Students at smaller schools were slightly more likely to participate. The average size of participating schools was significantly smaller than non-participating schools at any level. Over half (54.9%) of students at schools in the lowest three quartiles of school size participated and only 26.7% of students in the largest quartile of school size participated.
- **Economically disadvantaged students were less likely to participate**. Students who were economically disadvantaged participated in FitnessGram® at a lower rate than their non-economically disadvantaged peers (6.5 percentage points lower in 2014–15;

4.7 percentage points lower in 2015–16). Further, schools with a higher proportion of students who are economically disadvantaged participated at significantly lower rates. This effect was pronounced in high schools where moving from a school in the lowest quartile of students with economically disadvantaged status to a school in the highest quartile (adjusting for all else) was associated with a 6 percentage point decrease in the probability of FitnessGram® participation (the difference for students in elementary schools was 3 percentage points and the difference for students in middle schools was not statistically significant). This effect was particularly pronounced for black students at these schools where moving from the lowest quartile of economically disadvantaged students at a campus to the highest quartile was associated with a 9.5 percentage point decrease in the probability of FitnessGram® participation (from 53.5% to 44%). In contrast, this same change in school proportion of economically disadvantaged students resulted in about a 1 percentage point decrease in the probability of FitnessGram® participation for Hispanic and White students.

- **Higher performing students and schools had higher propensities for participation**. Moving from the bottom to the top quartile in mathematics performance increased the probability of FitnessGram® participation by about 1.5 percentage points for elementary and middle school students (the effect was not significant for high school students). Students with higher STAAR mathematics scores in the year prior were more likely to be assessed with FitnessGram®, with the exception of high school students.[34] Schools with overall higher mathematics performance were associated with significantly higher levels of FitnessGram® participation.

[34] Interestingly, students in the top 10 percent of mathematics standardized exam performance in high school were 70 percent less likely to take FitnessGram®. We suspect this signals something about academic differentiation and participation in physical education in higher grade levels.

Bivariate Analysis

Since none of the FitnessGram® HFZ measures are continuous, Spearman's correlation coefficients were used for comparisons[35]. In order to calculate Spearman correlation coefficients, the first step is to transform x and y[36] into their rank or position relative to the other observations' values ($x'$and y'). Then, the formula for calculating the Spearman correlation coefficient is:

$$r = \frac{\sum_{i=1}^{n}(x'_i - \bar{x}')(y'_i - \bar{y}')}{\sqrt{\sum_{i=1}^{n}(x'_i - \bar{x}')^2}\sqrt{\sum_{i=1}^{n}(y'_i - \bar{y}')^2}}$$

In the equation, $\bar{x}'$ and $\bar{y}'$ represent the average value (or rank for Spearman's correlation coefficients) of x' and y' in the sample, n is the number of observations, and i is an index of each observation. These coefficients are presented in the bivariate analyses.

Multivariate Analysis

Each outcome of interest was modeled in a regression model with clustered standard errors designed for cases where students are nested in groups (i.e., schools). These models can account for both the influence of multiple student and school-level factors in the outcomes of interest and that students' outcomes in the same school are related which can cause biased standard errors if not corrected.

Table B.7. outlines information about each model, which changes depending on the outcome of interest.

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[35] While body fat and BMI measures are reported as continuous, in order to compare them across grade level and gender, percentile ranking is necessary. This transformation makes them very similar. Using Spearman's correlation coefficients also makes all of the correlations comparable.

[36] Where X and Y are variables of interest, such as Aerobic Capacity and STAAR mathematics

Table B.7. – Model Information by Research Question and Outcome Variable

Research Question	Outcome Variable	Model (Distribution of the Data)
2.1 Relationship between HFZ and STAAR?	STAAR mathematics	Linear
	STAAR reading	Linear
2.2 Relationship between HFZ and attendance?	Attendance rate	Linear
2.3. Relationship between obesity and HFZ?	Body Composition HFZ	Linear
2.4. Relationship between Disciplinary problems and HFZ?	Student had ISS	Logit
	Student had OSS	Logit
2.5. Relationship between participation in school meal programs and HFZ?	Aerobic Capacity	Logit
	Body Composition	Logit
	Abdominal Strength and Endurance	Logit
	Upper body Strength and Endurance	Logit
	Flexibility	Logit
	Trunk Extensor Strength	Logit
	Aerobic Capacity	Logit

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Two types of models were estimated: models employing a lagged dependent variable to control for the prior level of the outcome, and for some outcomes, difference models which take the within-student difference from the last period of the time variant variables. Both of these models accounted for differences in second-level clustering of students within schools using a standard error cluster-adjustment to allow student observations within schools to be correlated across and within schools (helping to account for heteroscedasticity and allowing for dependence within a year but independence across years). The general form and variables included in each type of model is presented below.

The functional form of the models utilizing the lagged dependent variable was:

$$Y_{it}= Y_{i(t-1)} +\beta_0+ \beta_{FG}X_{FG}+ \beta_{IC}X_{IC}+ \beta_{SC}X_{SC} +\varepsilon_i$$

Where:

- Y_{it} represents the outcome of interest (e.g. STAAR mathematics percentile)
- $Y_{i(t-1)}$ represents that student's outcome in the prior year
- β_{FG} is a vector of regression coefficients associated with the FitnessGram® variables of interest (X_{FG})

- Aerobic Capacity
- Body Composition
- Upper Body Strength
- Abdominal Strength and Endurance
- Trunk Extensor Strength
- Flexibility

- β_{IC} is a vector of regression coefficients associated with individual level student controls (X_{IC})
  - Economic disadvantaged status
  - Special education program participation
  - English language learner status
  - Age
  - Race/Ethnicity
- β_{SC} is a vector of regression coefficients associated with school level controls (X_{SC})
  - School size
  - Campus economically disadvantaged percentage
- β_0 is a constant
- ε_i is the student-level disturbance term

The functional form of the difference models was:

$$\Delta Y_{it} = \beta_0 + \beta_{FG}\Delta X_{FG} + \beta_{TV}\Delta X_{TV} + \beta_{TIV}X_{TIV} + \beta_{SC}X_{SC} + \varepsilon_i$$

Where:

- ΔY_{it} represents the change in the outcome of interest from the prior year
- β_{FG} is a vector of regression coefficients associated with the change in the FitnessGram® variables of interest from the prior year(ΔX_{FG})
  - Change in Aerobic Capacity
  - Change in Body Composition
  - Change in Upper Body Strength
  - Change in Abdominal Strength and Endurance
  - Change in Trunk Extensor Strength
  - Change in Flexibility
- β_{TV} is a vector of regression coefficients associated with change in time-variant-individual-level student controls(ΔX_{TV})

- Change in economic disadvantaged status

- β_{TIV} is a vector of time-invariant-individual-level controls (X_{TIV})
    - Special education program participation
    - English language learner status
    - Age (not time invariant, but increases with time at a constant rate)
    - Race/Ethnicity
- β_{SC} is a vector of regression coefficients associated with school level controls, such as percent of economic disadvantaged (X_{SC})
    - School size
    - Campus economically disadvantaged percentage
- β_0 is a constant
- ε_i is the student-level disturbance term

Appendix C – Additional Descriptive, Correlational, and Multivariate Regression Output Tables

The following tables provide more information on tables and figures presented in the body of the report. First, descriptive tables relating to the figures in Chapter 2 are presented, followed by the statewide correlation tables. Second, the full regression models for the figures included in the report are presented.

Additional Descriptive Tables

Table C-1. Percent of Students Meeting the Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators Overall, 2014–15 and 2015–16

HFZ	2014–15 Percent in HFZ	2015–16 Percent in HFZ	Percentage Point Change in HFZ
Aerobic Capacity HFZ	60.3%	57.7%	-2.6%
Body Composition HFZ	61.7%	61.8%	0.1%
Upper Body HFZ	74.1%	73.7%	-0.4%
Abdominal HFZ	80.3%	79.2%	-1.1%
Trunk Extensor Strength HFZ	86.5%	85.9%	-0.6%
Flexibility HFZ	76.3%	75.8%	-0.5%

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16, Texas Education Agency.

Table C-2. Percent of Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators by Gender, 2014–15 and 2015–16

HFZ	2014–15 Percent in HFZ, Male	2015–16 Percent in HFZ, Male	Percentage Point Change in HFZ, Male	2014–15 Percent in HFZ, Female	2015–16 Percent in HFZ, Female	Percentage Point Change in HFZ, Female
Aerobic Capacity HFZ	64.4%	61.9%	-2.5%	55.9%	53.3%	-2.6%
Body Composition HFZ	59.8%	60.0%	0.2%	63.8%	63.8%	0.0%
Upper Body HFZ	74.9%	74.2%	-0.7%	73.1%	73.0%	-0.1%
Abdominal HFZ	81.0%	79.7%	-1.3%	79.6%	78.7%	-0.9%
Trunk Extensor Strength HFZ	85.2%	84.5%	-0.7%	87.9%	87.5%	-0.4%
Flexibility HFZ	73.7%	73.1%	-0.6%	79.1%	78.8%	-0.3%

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16, Texas Education Agency.

Table C-3. – Percent of Students Meeting Healthy Fitness Zone Thresholds by Number of Indicators by Gender, 2014–15 and 2015–16

Number of HFZs	2014–15 Percent Male in HFZ	2015–16 Percent Male in HFZ	Percentage Point Change in HFZ, Male	2014–15 Percent Female in HFZ	2015–16 Percent Female in HFZ	Percentage Point Change in HFZ, Female
Not in any HFZ	1.4%	1.9%	0.5%	1.1%	1.5%	0.4%
Exactly 1 HFZ	4.3%	5.0%	0.7%	3.4%	4.4%	1.0%
Exactly 2 HFZs	9.3%	9.9%	0.6%	7.7%	8.8%	1.1%
Exactly 3 HFZs	17.7%	16.8%	-0.9%	16.1%	15.7%	-0.4%
Exactly 4 HFZs	27.7%	22.2%	-5.5%	27.2%	23.0%	-4.2%
Exactly 5 HFZs	29.4%	23.9%	-5.5%	32.5%	24.0%	-8.5%
Exactly 6 HFZs	10.1%	20.2%	10.1%	11.9%	22.7%	10.8%

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16, Texas Education Agency.

Table C-4. – Percent of Students Meeting Healthy Fitness Zone Thresholds for Six FitnessGram® Indicators by School Level and Gender, *2014–15 and 2015–16*

HFZ	2014–15 Percent in HFZ, Male	2015–16 Percent in HFZ, Male	Percentage Point Change in HFZ, Male	2014–15 Percent in HFZ, Female	2015–16 Percent in HFZ, Female	Percentage Point Change in HFZ, Female
Elementary Schools						
Aerobic Capacity HFZ	70.1%	66.1%	-4.0%	61.3%	55.7%	-5.6%
Body Composition HFZ	58.3%	59.0%	0.7%	62.0%	62.5%	0.5%
Upper Body HFZ	75.2%	74.4%	-0.8%	68.2%	68.4%	0.2%
Abdominal HFZ	79.7%	78.3%	-1.4%	78.5%	77.2%	-1.3%
Trunk Extensor Strength HFZ	83.4%	82.2%	-1.2%	86.7%	85.7%	-1.0%
Flexibility HFZ	69.5%	69.0%	-0.5%	77.5%	77.2%	-0.3%
Middle Schools						
Aerobic Capacity HFZ	65.9%	64.7%	-1.2%	54.8%	54.2%	-0.6%
Body Composition HFZ	60.5%	60.8%	0.3%	62.8%	63.1%	0.3%
Upper Body HFZ	76.0%	75.5%	-0.5%	76.5%	76.9%	0.4%
Abdominal HFZ	83.3%	82.1%	-1.2%	80.5%	80.2%	-0.3%
Trunk Extensor Strength HFZ	85.1%	84.9%	-0.2%	87.7%	88.1%	0.4%
Flexibility HFZ	76.5%	76.4%	-0.1%	82.0%	81.7%	-0.3%

HFZ	2014–15 Percent in HFZ, Male	2015–16 Percent in HFZ, Male	Percentage Point Change in HFZ, Male	2014–15 Percent in HFZ, Female	2015–16 Percent in HFZ, Female	Percentage Point Change in HFZ, Female
High Schools						
Aerobic Capacity HFZ	48.3%	49.5%	1.2%	44.2%	46.9%	2.7%
Body Composition HFZ	62.0%	61.0%	-1.0%	69.6%	68.9%	-0.7%
Upper Body HFZ	72.6%	71.1%	-1.5%	79.2%	79.0%	-0.2%
Abdominal HFZ	80.7%	79.5%	-1.2%	81.0%	80.4%	-0.6%
Trunk Extensor Strength HFZ	89.5%	89.8%	0.3%	91.5%	91.3%	-0.2%
Flexibility HFZ	79.1%	78.5%	-0.6%	78.3%	78.6%	0.3%

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16, Texas Education Agency.

Statewide Bivariate Correlation Coefficient Tables

Table C-5. – Statewide Bivariate Correlation Coefficient Table, 2014–15

Fitness Measure	STAAR Mathematics	STAAR Reading	Attendance Rate	ISS	OSS	Students Eligible for Free Meals	Students Eligible for Reduced-Price Meals	Students with Other Economic Disadvantage	Body Fat Percentile	BMI Percentile
Aerobic Capacity HFZ	0.150***	0.134***	0.150***	-0.076***	-0.068***	-0.078***	-0.003**	-0.047***	-0.288***	-0.319***
Body Composition HFZ	0.086***	0.094***	0.054***	-0.017***	-0.014***	-0.098***	-0.011***	-0.050***	-0.703***	-0.853***
Upper Body Strength	0.089***	0.085***	0.051***	-0.019***	-0.022***	-0.058***	-0.005***	-0.033***	-0.212***	-0.223***
Abdominal Strength	0.109***	0.110***	0.058***	-0.029***	-0.033***	-0.074***	-0.002***	-0.037***	-0.118***	-0.168***
Trunk Extensor Strength	0.054***	0.057***	0.008***	-0.014***	-0.024***	-0.035***	-0.001	-0.024***	-0.005	0.024***
Flexibility	0.081***	0.091***	0.032***	-0.016***	-0.011***	-0.046***	-0.003***	-0.035***	-0.150***	-0.158***
Body Fat Percentile	-0.061***	-0.058***	-0.066***	0.017***	0.015***	0.047***	0.010**	0.056***	N/A	0.673***
BMI Percentile	-0.105***	-0.107***	-0.073***	0.036***	0.028***	0.113***	0.011***	0.055***	0.673***	N/A

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-6. – Statewide Bivariate Correlation Coefficient Table, 2015–16

Fitness Measure	STAAR Mathematics	STAAR Reading	Attendance Rate	ISS	OSS	Students Eligible for Free Meals	Students Eligible for Reduced-Price Meals	Students with Other Economic Disadvantage	Body Fat Percentile	BMI Percentile
Aerobic Capacity HFZ	0.127***	0.115***	0.131***	-0.061***	-0.059***	-0.094***	-0.006***	-0.056***	-0.319***	-0.399***
Body Composition HFZ	0.072***	0.082***	0.057***	-0.020***	-0.016***	-0.092***	-0.009***	-0.054***	-0.711***	-0.856***
Upper Body Strength	0.076***	0.075***	0.053***	-0.019***	-0.018***	-0.050***	-0.002**	-0.041***	-0.227***	-0.219***
Abdominal Strength	0.096***	0.097***	0.058***	-0.027***	-0.030***	-0.067***	-0.002**	-0.043***	-0.136***	-0.173***
Trunk Extension	0.040***	0.050***	0.010***	-0.012***	-0.020***	-0.026***	0.002*	-0.030***	0.008	0.018***
Flexibility	0.078***	0.088***	0.035***	-0.016***	-0.012***	-0.047***	-0.002**	-0.040***	-0.136***	-0.159***
Body Fat Percentile	-0.055***	-0.042***	-0.045***	0.002	0.014**	0.047***	0.011*	0.023***	N/A	0.668***
BMI Percentile	-0.089***	-0.089***	-0.073***	0.034***	0.027***	0.106***	0.009***	0.059***	0.668***	N/A

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Full Regression Model Results

This chapter presents the full regression model results for the figures in Chapter 3. Standard errors are in parentheses. In addition to the models presented in Chapter 3, models without a lagged dependent variable control are presented for research questions 3.3 and 3.5. This is because these research questions used FitnessGram® dependent variables which were not available in 2013–14 which prevented the estimation of models with lagged dependent variables. For this reason, results were only presented for 2015–16 for these research questions. This appendix also provides the results for models without the lagged dependent variable as a control so as to be able to present models for 2014–15 for these research questions. They should be interpreted cautiously because prior performance is an important control and excluding it leads to larger effect size estimates than would otherwise be expected.

STAAR Mathematics and STAAR Reading Models

Table C-7. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, 2014–15 and 2015–16

	STAAR Mathematics			
Independent Variables	**2014–15**		**2015–16**	
	Male	**Female**	**Male**	**Female**
Economically Disadvantaged	-2.019***	-1.581***	-1.235***	-0.892***
	(0.10)	(0.10)	(0.09)	(0.09)
Special Education	-4.133***	-3.977***	-2.432***	-2.915***
	(0.22)	(0.28)	(0.16)	(0.20)
English Language Learner	-1.377***	-0.721***	-0.684***	-0.541***
	(0.15)	(0.15)	(0.14)	(0.14)
Asian	5.416***	5.810***	3.251***	3.727***
	(0.33)	(0.31)	(0.36)	(0.39)
Black	-4.663***	-2.828***	-3.051***	-2.105***
	(0.20)	(0.19)	(0.18)	(0.18)
Hispanic	-1.231***	-0.751***	0.112	0.209
	(0.16)	(0.16)	(0.15)	(0.15)

	STAAR Mathematics			
Independent Variables	**2014–15**		**2015–16**	
	Male	**Female**	**Male**	**Female**
American Indian or Alaskan Native	-1.081	-1.583**	-0.147	0.241
	(0.58)	(0.57)	(0.51)	(0.50)
Pacific Islander	0.017	2.252*	1.240	0.879
	(0.89)	(0.92)	(0.84)	(0.81)
Two or More	-0.219	-0.404	-0.322	-0.320
	(0.26)	(0.26)	(0.24)	(0.23)
Age	-0.341***	0.044	-0.271**	0.199*
	(0.08)	(0.09)	(0.09)	(0.09)
Aerobic Capacity HFZ	1.349***	1.171***	1.029***	0.907***
	(0.12)	(0.12)	(0.11)	(0.11)
Upper Body HFZ	0.234	0.424***	-0.015	0.221*
	(0.12)	(0.12)	(0.10)	(0.11)
Abdominal HFZ	0.978***	0.834***	0.650***	0.635***
	(0.13)	(0.13)	(0.12)	(0.11)
Trunk Extensor Strength HFZ	0.303	0.272	0.280*	0.401**
	(0.16)	(0.16)	(0.14)	(0.14)
Flexibility HFZ	0.668***	0.495***	0.538***	0.433***
	(0.11)	(0.13)	(0.10)	(0.12)
Body Composition HFZ	-0.208*	-0.340***	-0.388***	-0.172*
	(0.08)	(0.08)	(0.07)	(0.08)
School Size	0.000	-0.000	0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)

	STAAR Mathematics			
Independent Variables	**2014–15**		**2015–16**	
	Male	**Female**	**Male**	**Female**
Campus Avg. Economically Disadvantaged	-5.452***	-4.450***	-3.933***	-3.469***
	(0.43)	(0.44)	(0.40)	(0.41)
Prior Reading Percentile	0.168***	0.180***	0.141***	0.152***
	(0.00)	(0.00)	(0.00)	(0.00)
Prior Mathematics Percentile	0.497***	0.513***	0.506***	0.519***
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	24.944***	17.585***	23.238***	15.784***
	(0.94)	(1.00)	(0.99)	(1.00)
R^2	0.468	0.490	0.425	0.438
BIC	3,763,698	3,557,840	4,895,203	4,602,412
N	421,226	402,340	543,506	514,308

Note: * p<0.05, ** p<0.01, *** p<0.001. Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-8. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, 2014–15 and 2015–16

	STAAR Reading			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-3.310***	-3.043***	-2.183***	-1.925***
	(0.10)	(0.09)	(0.08)	(0.08)
Special Education	-5.698***	-4.849***	-2.685***	-3.909***
	(0.22)	(0.29)	(0.15)	(0.19)
English language learner	-5.430***	-4.994***	-3.743***	-4.322***
	(0.14)	(0.15)	(0.12)	(0.13)
Asian	2.763***	2.245***	3.581***	2.353***
	(0.21)	(0.20)	(0.28)	(0.29)
Black	-3.810***	-2.991***	-1.376***	-1.296***
	(0.17)	(0.16)	(0.13)	(0.15)
Hispanic	-1.504***	-1.743***	0.260*	0.074
	(0.12)	(0.12)	(0.11)	(0.13)
American Indian or Alaskan Native	-1.693**	-1.796***	-0.954*	-1.006*
	(0.52)	(0.55)	(0.46)	(0.45)
Pacific Islander	-0.853	-0.299	1.003	0.159
	(0.78)	(0.74)	(0.74)	(0.71)
Two or More	-0.164	0.376	0.491*	0.167
	(0.25)	(0.22)	(0.22)	(0.21)
Age	-0.413***	-0.311***	-0.285***	-0.056
	(0.05)	(0.06)	(0.04)	(0.05)
Aerobic Capacity HFZ	0.916***	1.067***	0.845***	0.906***

	STAAR Reading			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.10)	(0.09)	(0.08)	(0.09)
Upper Body HFZ	0.185*	0.263**	-0.058	0.118
	(0.09)	(0.09)	(0.08)	(0.10)
Abdominal HFZ	0.898***	0.862***	0.344***	0.601***
	(0.10)	(0.10)	(0.09)	(0.09)
Trunk Extensor Strength HFZ	0.247	0.431***	-0.121	0.154
	(0.13)	(0.13)	(0.11)	(0.11)
Flexibility HFZ	0.567***	0.782***	0.379***	0.684***
	(0.09)	(0.10)	(0.08)	(0.10)
Body Composition HFZ	-0.302***	-0.271***	-0.470***	-0.429***
	(0.07)	(0.07)	(0.07)	(0.07)
School Size	-0.000	0.000	-0.000**	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-4.920***	-4.317***	-2.672***	-2.704***
	(0.31)	(0.28)	(0.34)	(0.37)
Prior Reading Percentile	0.542***	0.558***	0.550***	0.568***
	(0.00)	(0.00)	(0.00)	(0.00)
Prior Mathematics Percentile	0.130***	0.142***	0.141***	0.143***
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	26.457***	24.067***	20.718***	19.086***
	(0.60)	(0.59)	(0.50)	(0.56)
R^2	0.526	0.559	0.503	0.522

	STAAR Reading			
	2014–15		2015–16	
	Male	Female	Male	Female
BIC	3,922,487	3,686,642	5,124,887	4,801,857
N	445,639	424,279	580,309	547,122

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-9. – Full Multivariate Change Model Results Between FitnessGram® HFZ Metrics and STAAR Mathematics and STAAR Reading Percentile Rank, 2014–15 and 2015–16

	Difference Models			
	Math		Reading	
Independent Variables	Male	Female	Male	Female
Asian	-2.069***	-1.963***	2.484***	1.714***
	(0.57)	(0.58)	(0.45)	(0.46)
Black	2.958***	3.154***	2.491***	2.129***
	(0.28)	(0.28)	(0.23)	(0.26)
Hispanic	1.154***	1.322***	1.652***	1.813***
	(0.23)	(0.22)	(0.17)	(0.21)
American Indian or Alaskan Native	1.659*	0.504	-0.034	0.144
	(0.81)	(0.96)	(0.77)	(0.83)
Pacific Islander	2.855*	1.894	4.271***	2.706*
	(1.33)	(1.21)	(1.14)	(1.14)
Two or More	0.691	0.472	1.440***	0.753*
	(0.44)	(0.41)	(0.40)	(0.36)

	Difference Models			
	Math		Reading	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Age	0.214	0.344*	0.422***	0.756***
	(0.15)	(0.16)	(0.08)	(0.08)
School Size	-0.001**	-0.002***	-0.001***	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	0.987	0.403	1.622**	1.323*
	(0.64)	(0.63)	(0.55)	(0.56)
Economic Disadvantage Increased	1.150***	1.282***	0.548*	0.387
	(0.26)	(0.26)	(0.22)	(0.23)
Economic Disadvantage Decreased	0.618*	0.578*	0.045	0.406
	(0.24)	(0.25)	(0.22)	(0.21)
Special Education	1.607***	1.378***	0.610*	-0.257
	(0.28)	(0.35)	(0.26)	(0.32)
English language learner	2.309***	2.056***	2.959***	1.586***
	(0.22)	(0.22)	(0.18)	(0.20)
Aerobic Capacity Decreased	-0.044	-0.283	-0.203	-0.251
	(0.18)	(0.17)	(0.15)	(0.15)
Upper Body Strength Decreased	0.196	0.309	-0.231	0.260
	(0.19)	(0.19)	(0.16)	(0.18)
Abdominal Strength Decreased	0.468*	0.627**	0.208	0.049
	(0.20)	(0.19)	(0.17)	(0.18)
Trunk Extensor Strength Decreased	-0.030	0.455	0.256	0.304
	(0.24)	(0.24)	(0.18)	(0.19)

	Difference Models			
	Math		Reading	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Flexibility Decreased	0.213	0.701**	0.124	-0.045
	(0.22)	(0.23)	(0.19)	(0.19)
Aerobic Capacity Increased	1.263***	1.071***	0.464*	0.369*
	(0.19)	(0.22)	(0.18)	(0.18)
Upper Body Strength Increased	0.862***	0.255	0.334	0.222
	(0.20)	(0.19)	(0.17)	(0.16)
Abdominal Strength Increased	0.788***	0.738***	0.264	0.106
	(0.21)	(0.20)	(0.17)	(0.18)
Trunk Extensor Strength Increased	0.269	0.472*	0.269	0.039
	(0.23)	(0.24)	(0.18)	(0.22)
Flexibility Increased	0.624**	0.214	0.150	0.352
	(0.19)	(0.21)	(0.17)	(0.19)
Body Composition Change	-0.127	0.449**	0.030	0.037
	(0.15)	(0.15)	(0.13)	(0.13)
Constant	-4.476**	-4.605**	-7.755**	-10.360***
	(1.48)	(1.59)	(0.90)	(0.87)
R^2	0.006	0.006	0.007	0.006
BIC	2,113,068	2,013,250	2,200,512	2,072,338
N	228,193	218,296	242,395	230,227

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-10. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, Elementary Schools, 2014–15 and 2015–16

Elementary Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-2.326***	-1.907***	-1.830***	-1.505***
	(0.12)	(0.12)	(0.10)	(0.10)
Special Education	-4.304***	-3.438***	-2.991***	-2.721***
	(0.29)	(0.37)	(0.21)	(0.27)
English language learner	-1.136***	-0.755***	0.134	0.368*
	(0.18)	(0.18)	(0.16)	(0.16)
Asian	5.640***	5.889***	4.444***	5.013***
	(0.29)	(0.28)	(0.30)	(0.24)
Black	-4.695***	-3.007***	-3.469***	-2.204***
	(0.24)	(0.23)	(0.20)	(0.20)
Hispanic	-0.920***	-0.483**	0.002	0.249
	(0.19)	(0.17)	(0.15)	(0.14)
American Indian or Alaskan Native	-1.180	-1.433*	-0.210	-0.432
	(0.78)	(0.70)	(0.70)	(0.59)
Pacific Islander	0.705	1.793	1.326	1.099
	(1.08)	(1.11)	(0.99)	(1.05)
Two or More	-0.344	-0.614*	-0.342	-0.105
	(0.32)	(0.30)	(0.27)	(0.27)
Age	-0.090	0.742***	-0.072	0.501***
	(0.13)	(0.14)	(0.11)	(0.12)
Aerobic Capacity HFZ	1.345***	1.085***	1.241***	1.107***

Elementary Schools	STAAR Mathematics			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.14)	(0.14)	(0.12)	(0.12)
Upper Body HFZ	0.294	0.406**	0.175	0.444***
	(0.15)	(0.15)	(0.12)	(0.12)
Abdominal HFZ	0.996***	0.679***	0.711***	0.659***
	(0.17)	(0.16)	(0.14)	(0.13)
Trunk Extensor Strength HFZ	0.249	0.290	0.352*	0.365*
	(0.18)	(0.19)	(0.15)	(0.16)
Flexibility HFZ	0.830***	0.742***	0.778***	0.806***
	(0.13)	(0.15)	(0.11)	(0.13)
Body Composition HFZ	-0.442***	-0.594***	-0.125	-0.158
	(0.10)	(0.10)	(0.09)	(0.09)
School Size	-0.001	-0.001	-0.002*	-0.002***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-5.185***	-4.049***	-3.736***	-2.997***
	(0.42)	(0.44)	(0.38)	(0.37)
Prior Reading Percentile	0.156***	0.174***	0.139***	0.157***
	(0.00)	(0.00)	(0.00)	(0.00)
Prior Mathematics Percentile	0.567***	0.574***	0.625***	0.634***
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	20.039***	8.906***	15.792***	7.491***
	(1.41)	(1.48)	(1.22)	(1.28)
R^2	0.555	0.583	0.605	0.626

Elementary Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
BIC	1,818,743	1,726,509	2,194,067	2,066,155
N	207,419	199,797	253,886	242,161

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-11. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, Elementary Schools, 2014–15 and 2015–16

Elementary Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-2.970***	-2.458***	-2.408***	-2.229***
	(0.12)	(0.11)	(0.10)	(0.10)
Special Education	-5.681***	-4.478***	-3.761***	-4.368***
	(0.28)	(0.35)	(0.21)	(0.26)
English language learner	-4.216***	-3.794***	-2.744***	-3.443***
	(0.17)	(0.18)	(0.14)	(0.15)
Asian	1.840***	1.816***	2.190***	1.569***
	(0.26)	(0.25)	(0.25)	(0.22)
Black	-3.596***	-2.498***	-0.937***	-0.877***
	(0.22)	(0.20)	(0.17)	(0.17)
Hispanic	-1.371***	-1.290***	0.333*	0.332**
	(0.15)	(0.15)	(0.13)	(0.12)

Elementary Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
American Indian or Alaskan Native	-2.392**	-1.802**	-0.341	-1.274*
	(0.75)	(0.69)	(0.62)	(0.59)
Pacific Islander	-0.615	-1.483	1.258	-0.416
	(1.05)	(0.97)	(0.99)	(1.00)
Two or More	-0.109	0.084	0.375	0.023
	(0.33)	(0.29)	(0.27)	(0.27)
Age	0.508***	-0.208	0.493***	-0.304**
	(0.11)	(0.11)	(0.09)	(0.10)
Aerobic Capacity HFZ	0.129	0.642***	0.638***	0.830***
	(0.12)	(0.12)	(0.11)	(0.11)
Upper Body HFZ	-0.238	0.081	-0.215*	0.194
	(0.13)	(0.12)	(0.11)	(0.10)
Abdominal HFZ	0.811***	0.558***	0.489***	0.345**
	(0.14)	(0.13)	(0.12)	(0.11)
Trunk Extensor Strength HFZ	0.200	0.297	-0.015	0.047
	(0.15)	(0.16)	(0.12)	(0.13)
Flexibility HFZ	0.591***	0.739***	0.438***	0.690***
	(0.11)	(0.12)	(0.10)	(0.11)
Body Composition HFZ	-0.563***	-0.437***	-0.622***	-0.527***
	(0.10)	(0.09)	(0.09)	(0.09)
School Size	-0.003***	-0.003***	-0.002**	-0.002***
	(0.00)	(0.00)	(0.00)	(0.00)

Elementary Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Campus Avg. Economically Disadvantaged	-4.398***	-4.089***	-3.229***	-3.015***
	(0.33)	(0.31)	(0.29)	(0.28)
Prior Reading Percentile	0.560***	0.571***	0.575***	0.579***
	(0.00)	(0.00)	(0.00)	(0.00)
Prior Mathematics Percentile	0.156***	0.171***	0.178***	0.192***
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	16.208***	22.156***	11.096***	20.042***
	(1.17)	(1.13)	(0.98)	(1.06)
R^2	0.567	0.599	0.589	0.610
BIC	1,810,856	1,720,940	2,199,208	2,078,176
N	207,526	199,869	253,884	242,161

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-12. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, Middle Schools, 2014–15 and 2015–16

Middle Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-1.556***	-1.510***	-0.619***	-0.418**
	(0.18)	(0.18)	(0.15)	(0.15)
Special Education	-4.109***	-4.564***	-1.595***	-2.768***
	(0.40)	(0.50)	(0.28)	(0.35)
English language learner	-2.237***	-1.390***	-2.003***	-2.193***
	(0.28)	(0.28)	(0.26)	(0.26)
Asian	4.599***	5.705***	1.490**	2.473***
	(0.62)	(0.59)	(0.56)	(0.57)
Black	-5.140***	-2.622***	-2.575***	-1.658***
	(0.35)	(0.37)	(0.29)	(0.31)
Hispanic	-2.072***	-1.127***	0.077	0.047
	(0.29)	(0.30)	(0.25)	(0.26)
American Indian or Alaskan Native	-1.510	-1.144	-0.560	0.999
	(0.99)	(1.05)	(0.86)	(0.99)
Pacific Islander	-0.173	4.151*	0.310	1.127
	(1.53)	(1.65)	(1.45)	(1.51)
Two or More	-0.401	0.113	-0.309	-0.357
	(0.46)	(0.48)	(0.44)	(0.41)
Age	-0.359	0.606**	-1.450***	-0.688**
	(0.19)	(0.22)	(0.23)	(0.25)

Middle Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Aerobic Capacity HFZ	0.968***	1.167***	0.603**	1.025***
	(0.21)	(0.23)	(0.19)	(0.19)
Upper Body HFZ	0.563**	0.662**	-0.159	0.197
	(0.21)	(0.23)	(0.18)	(0.22)
Abdominal HFZ	0.637*	0.669**	0.249	0.334
	(0.25)	(0.24)	(0.22)	(0.21)
Trunk Extensor Strength HFZ	0.276	0.259	-0.016	0.316
	(0.32)	(0.31)	(0.26)	(0.28)
Flexibility HFZ	0.195	0.332	0.127	-0.111
	(0.21)	(0.23)	(0.18)	(0.22)
Body Composition HFZ	0.074	-0.140	-0.435**	-0.302*
	(0.15)	(0.13)	(0.13)	(0.15)
School Size	0.002**	0.001*	0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-7.324***	-6.353***	-5.161***	-4.627***
	(0.90)	(0.93)	(0.75)	(0.79)
Prior Reading Percentile	0.170***	0.177***	0.136***	0.141***
	(0.01)	(0.01)	(0.01)	(0.00)
Prior Mathematics Percentile	0.415***	0.439***	0.371***	0.382***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	29.619***	14.092***	45.940***	34.775***
	(2.56)	(2.88)	(3.12)	(3.40)

Middle Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
R^2	0.398	0.409	0.271	0.272
BIC	1,483,403	1,396,629	1,926,040	1,823,676
N	163,974	155,236	208,419	197,670

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-13. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, Middle Schools, 2014–15 and 2015–16

Middle Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-3.652***	-3.716***	-1.783***	-1.414***
	(0.18)	(0.16)	(0.15)	(0.15)
Special Education	-5.693***	-5.103***	-2.022***	-3.567***
	(0.42)	(0.55)	(0.26)	(0.35)
English language learner	-7.626***	-8.088***	-5.174***	-5.932***
	(0.25)	(0.26)	(0.24)	(0.24)
Asian	1.941***	1.437***	3.583***	2.175**
	(0.38)	(0.30)	(0.63)	(0.68)
Black	-4.240***	-2.885***	-1.722***	-1.059***
	(0.34)	(0.30)	(0.26)	(0.31)
Hispanic	-1.958***	-2.146***	0.211	0.181
	(0.23)	(0.21)	(0.23)	(0.28)
American Indian or Alaskan Native	-1.049	-1.782	-1.594*	-0.999
	(0.91)	(0.97)	(0.81)	(0.89)
Pacific Islander	-1.933	1.156	0.683	1.075
	(1.20)	(1.20)	(1.22)	(1.25)
Two or More	-0.643	1.124**	0.670	0.724
	(0.43)	(0.37)	(0.44)	(0.40)
Age	-0.841***	0.159	0.166	0.788***
	(0.11)	(0.12)	(0.09)	(0.10)

Middle Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Aerobic Capacity HFZ	1.013***	1.087***	0.516***	0.818***
	(0.16)	(0.15)	(0.15)	(0.17)
Upper Body HFZ	0.643***	0.561***	-0.020	-0.063
	(0.16)	(0.16)	(0.16)	(0.21)
Abdominal HFZ	0.911***	1.034***	0.064	0.680***
	(0.17)	(0.16)	(0.17)	(0.19)
Trunk Extensor Strength HFZ	0.302	0.430	-0.382	-0.025
	(0.25)	(0.24)	(0.24)	(0.25)
Flexibility HFZ	0.474**	0.506**	0.052	0.458*
	(0.15)	(0.17)	(0.16)	(0.20)
Body Composition HFZ	-0.130	-0.259*	-0.431***	-0.614***
	(0.12)	(0.11)	(0.12)	(0.12)
School Size	0.000	0.001*	0.001*	0.001*
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-6.066***	-4.975***	-2.261**	-2.302**
	(0.60)	(0.54)	(0.79)	(0.88)
Prior Reading Percentile	0.500***	0.506***	0.520***	0.532***
	(0.01)	(0.01)	(0.00)	(0.00)
Prior Mathematics Percentile	0.147***	0.164***	0.127***	0.132***
	(0.00)	(0.00)	(0.01)	(0.01)
Constant	33.660***	20.060***	16.408***	9.681***
	(1.43)	(1.44)	(1.42)	(1.49)

Middle Schools	STAAR Reading			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
R^2	0.528	0.553	0.447	0.451
BIC	1,445,286	1,351,908	1,866,002	1,765,923
N	164,078	155,325	208,428	197,660

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-14. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Mathematics Percentile Rank, High Schools, 2014–15 and 2015–16

High Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-2.134***	-0.922**	-2.077***	-1.522***
	(0.34)	(0.33)	(0.25)	(0.27)
Special Education	-4.802***	-6.608***	-2.650***	-4.535***
	(0.71)	(0.88)	(0.46)	(0.59)
English language learner	-2.615***	0.483	-1.211*	-0.788
	(0.58)	(0.59)	(0.56)	(0.58)
Asian	9.085***	5.272***	7.213***	6.523***
	(0.94)	(1.16)	(0.78)	(0.82)
Black	-4.231***	-3.079***	-3.597***	-3.439***
	(0.66)	(0.58)	(0.56)	(0.59)
Hispanic	-0.523	-0.868	-0.165	-0.327
	(0.49)	(0.51)	(0.44)	(0.42)
American Indian or Alaskan Native	0.172	-4.236	-0.288	-0.798
	(2.29)	(2.70)	(2.06)	(1.54)
Pacific Islander	-5.994	0.331	3.039	-2.603
	(3.39)	(4.89)	(3.02)	(2.08)
Two or More	0.322	-1.854	-1.007	-0.805
	(1.15)	(1.14)	(0.84)	(0.91)
Age	2.307***	1.845***	1.453***	1.541***
	(0.31)	(0.35)	(0.25)	(0.29)
Aerobic Capacity HFZ	2.357***	1.603***	2.687***	2.246***

High Schools	STAAR Mathematics			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.41)	(0.39)	(0.33)	(0.34)
Upper Body HFZ	-0.262	1.367**	0.717*	1.242***
	(0.40)	(0.49)	(0.35)	(0.37)
Abdominal HFZ	1.915***	2.427***	2.028***	2.558***
	(0.46)	(0.47)	(0.38)	(0.40)
Trunk Extensor Strength HFZ	0.277	0.527	1.151*	1.543*
	(0.56)	(0.67)	(0.48)	(0.60)
Flexibility HFZ	1.268**	-0.292	0.281	0.456
	(0.42)	(0.47)	(0.34)	(0.40)
Body Composition HFZ	0.178	0.245	-0.894***	-0.429
	(0.29)	(0.32)	(0.25)	(0.26)
School Size	0.001	0.001	0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	1.660	2.340	1.234	-0.041
	(1.71)	(1.79)	(1.59)	(1.70)
Prior Reading Percentile	0.195***	0.239***	0.156***	0.161***
	(0.01)	(0.01)	(0.01)	(0.01)
Prior Mathematics Percentile	0.519***	0.538***	0.512***	0.531***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-21.557***	-18.381***	-3.858	-4.569
	(4.71)	(5.11)	(3.66)	(4.14)
R^2	0.361	0.413	0.380	0.427

High Schools	STAAR Mathematics			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
BIC	270,407	230,957	407,823	338,470
N	29,790	25,829	45,173	38,060

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Table C-15. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and STAAR Reading Percentile Rank, High Schools, 2014–15 and 2015–16

High Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-3.270***	-2.796***	-2.579***	-2.449***
	(0.25)	(0.24)	(0.22)	(0.20)
Special Education	-6.420***	-4.629***	-1.321**	-1.797***
	(0.64)	(0.82)	(0.40)	(0.52)
English language learner	-5.457***	-3.489***	-5.171***	-4.509***
	(0.48)	(0.58)	(0.33)	(0.45)
Asian	5.690***	5.077***	8.095***	5.369***
	(0.69)	(0.59)	(0.54)	(0.47)
Black	-3.567***	-4.925***	-2.266***	-3.131***
	(0.45)	(0.48)	(0.35)	(0.35)
Hispanic	-1.272***	-2.067***	-0.758**	-1.723***
	(0.36)	(0.37)	(0.27)	(0.27)

High Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
American Indian or Alaskan Native	-1.243	-2.798	-3.461*	-1.691
	(1.35)	(2.01)	(1.42)	(1.32)
Pacific Islander	-0.079	2.315	1.078	-1.385
	(3.19)	(3.11)	(2.40)	(1.83)
Two or More	0.240	-0.359	-0.203	-0.729
	(0.79)	(0.72)	(0.57)	(0.63)
Age	-1.441***	-4.205***	-1.519***	-5.534***
	(0.22)	(0.27)	(0.18)	(0.23)
Aerobic Capacity HFZ	1.955***	1.217***	1.899***	1.639***
	(0.28)	(0.26)	(0.21)	(0.22)
Upper Body HFZ	0.247	0.955***	0.541**	0.804***
	(0.25)	(0.28)	(0.21)	(0.23)
Abdominal HFZ	1.279***	1.632***	0.685**	1.503***
	(0.30)	(0.30)	(0.24)	(0.25)
Trunk Extensor Strength HFZ	0.400	0.295	0.449	0.188
	(0.45)	(0.55)	(0.32)	(0.33)
Flexibility HFZ	0.326	0.661*	0.363	0.738***
	(0.29)	(0.30)	(0.22)	(0.22)
Body Composition HFZ	0.856***	0.532*	0.130	0.131
	(0.22)	(0.23)	(0.18)	(0.19)
School Size	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)

High Schools	STAAR Reading			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Campus Avg. Economically Disadvantaged	-4.570***	-4.678***	-3.879***	-4.960***
	(0.97)	(0.99)	(0.73)	(0.70)
Prior Reading Percentile	0.516***	0.556***	0.500***	0.532***
	(0.01)	(0.01)	(0.01)	(0.01)
Prior Mathematics Percentile	0.007	0.020**	0.078***	0.067***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	45.448***	86.502***	42.349***	106.292***
	(3.32)	(4.05)	(2.70)	(3.40)
R^2	0.387	0.465	0.401	0.488
BIC	473,059	409,642	709,648	602,371
N	52,787	46,360	79,662	68,674

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency; and State of Texas Assessments of Academic Readiness results for reading and mathematics, 2014–15 and 2015–16, Texas Education Agency.

Attendance Models

Table C-16. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and Attendance Rate, 2014–15 and 2015–16

	Attendance Rate			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.250***	-0.229***	-0.315***	-0.304***
	(0.02)	(0.02)	(0.01)	(0.01)
Special Education	-0.181***	-0.161***	-0.186***	-0.231***
	(0.02)	(0.03)	(0.02)	(0.02)
English language learner	0.175***	0.273***	0.163***	0.183***
	(0.03)	(0.02)	(0.02)	(0.02)
Asian	0.599***	0.669***	0.520***	0.574***
	(0.03)	(0.03)	(0.03)	(0.02)
Black	0.144***	0.225***	0.086**	0.125***
	(0.04)	(0.03)	(0.03)	(0.03)
Hispanic	0.085***	0.123***	0.076***	0.107***
	(0.02)	(0.02)	(0.02)	(0.02)
American Indian or Alaskan Native	0.138	-0.006	-0.210*	-0.095
	(0.09)	(0.10)	(0.08)	(0.08)
Pacific Islander	-0.119	0.344**	0.087	0.033
	(0.15)	(0.13)	(0.12)	(0.11)
Two or More	0.002	0.024	-0.015	0.065*
	(0.04)	(0.04)	(0.03)	(0.03)
Age	-0.180***	-0.185***	-0.160***	-0.180***
	(0.01)	(0.01)	(0.01)	(0.01)

	Attendance Rate			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Aerobic Capacity HFZ	0.300***	0.319***	0.271***	0.281***
	(0.02)	(0.02)	(0.02)	(0.01)
Upper Body HFZ	0.046*	0.157***	0.059***	0.161***
	(0.02)	(0.02)	(0.02)	(0.02)
Abdominal HFZ	0.147***	0.227***	0.164***	0.231***
	(0.02)	(0.02)	(0.02)	(0.02)
Trunk Extensor Strength HFZ	0.024	0.000	0.082***	0.057*
	(0.02)	(0.02)	(0.02)	(0.02)
Flexibility HFZ	0.037*	0.101***	0.033*	0.131***
	(0.02)	(0.02)	(0.01)	(0.02)
Body Composition HFZ	-0.015	0.014	0.001	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)
School Size	-0.000	-0.000**	-0.000*	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.411***	-0.222***	-0.554***	-0.375***
	(0.06)	(0.05)	(0.05)	(0.05)
Prior Percent Attendance	0.705***	0.680***	0.674***	0.657***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	30.219***	32.340***	33.340***	34.931***
	(0.82)	(0.70)	(0.83)	(0.87)
R^2	0.394	0.391	0.391	0.393
BIC	2,279,417	2,093,991	3,368,936	3,073,760

	Attendance Rate			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
N	426,157	399,459	641,896	596,386

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-17. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and Attendance Rate, Elementary Schools, 2014–15 and 2015–16

Elementary Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-0.220***	-0.175***	-0.261***	-0.215***
	(0.02)	(0.02)	(0.01)	(0.01)
Special Education	-0.171***	-0.162***	-0.150***	-0.241***
	(0.02)	(0.03)	(0.02)	(0.03)
English language learner	0.411***	0.393***	0.381***	0.345***
	(0.02)	(0.02)	(0.02)	(0.02)
Asian	0.626***	0.703***	0.601***	0.680***
	(0.03)	(0.03)	(0.02)	(0.03)
Black	0.369***	0.400***	0.255***	0.346***
	(0.03)	(0.03)	(0.03)	(0.02)
Hispanic	0.178***	0.229***	0.216***	0.272***
	(0.02)	(0.02)	(0.02)	(0.02)
American Indian or Alaskan Native	0.108	-0.039	-0.083	-0.090
	(0.11)	(0.13)	(0.11)	(0.11)

Elementary Schools	Attendance Rate			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Pacific Islander	0.279	0.394*	0.078	0.102
	(0.15)	(0.16)	(0.15)	(0.14)
Two or More	0.070	0.102*	0.069	0.079*
	(0.05)	(0.05)	(0.04)	(0.04)
Age	-0.133***	-0.086***	-0.126***	-0.089***
	(0.01)	(0.01)	(0.01)	(0.01)
Aerobic Capacity HFZ	0.248***	0.258***	0.221***	0.210***
	(0.02)	(0.02)	(0.02)	(0.01)
Upper Body HFZ	0.030	0.059***	-0.010	0.042**
	(0.02)	(0.02)	(0.02)	(0.01)
Abdominal HFZ	0.051**	0.095***	0.107***	0.113***
	(0.02)	(0.02)	(0.02)	(0.02)
Trunk Extensor Strength HFZ	-0.004	-0.034	0.010	0.025
	(0.02)	(0.02)	(0.02)	(0.02)
Flexibility HFZ	0.038*	0.086***	0.030*	0.096***
	(0.02)	(0.02)	(0.01)	(0.02)
Body Composition HFZ	0.042**	0.030*	0.074***	0.030*
	(0.01)	(0.01)	(0.01)	(0.01)
School Size	-0.000	-0.000*	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.220***	-0.080	-0.292***	-0.153***
	(0.04)	(0.04)	(0.04)	(0.04)

Elementary Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Prior Percent Attendance	0.609***	0.589***	0.580***	0.564***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	38.812***	40.163***	41.997***	42.968***
	(0.67)	(0.71)	(0.58)	(0.57)
R^2	0.368	0.356	0.366	0.358
BIC	912,832	866,233	1,225,242	1,156,724
N	189,337	181,408	257,352	245,127

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-18. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and Attendance Rate, Middle Schools, 2014–15 and 2015–16

Middle Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.350***	-0.293***	-0.355***	-0.355***
	(0.02)	(0.02)	(0.02)	(0.02)
Special Education	-0.226***	-0.195***	-0.221***	-0.199***
	(0.04)	(0.05)	(0.03)	(0.04)
English language learner	0.074	0.159***	0.061	0.017
	(0.04)	(0.04)	(0.03)	(0.03)
Asian	0.761***	0.801***	0.607***	0.689***
	(0.04)	(0.04)	(0.04)	(0.03)

Middle Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Black	0.182***	0.249***	0.158**	0.178***
	(0.05)	(0.06)	(0.05)	(0.04)
Hispanic	0.193***	0.235***	0.178***	0.195***
	(0.03)	(0.03)	(0.02)	(0.03)
American Indian or Alaskan Native	0.097	0.164	-0.266*	-0.251
	(0.16)	(0.18)	(0.13)	(0.14)
Pacific Islander	-0.193	0.217	0.208	0.115
	(0.21)	(0.20)	(0.15)	(0.15)
Two or More	0.050	0.027	-0.067	0.146**
	(0.06)	(0.07)	(0.05)	(0.05)
Age	-0.121***	-0.168***	-0.150***	-0.211***
	(0.02)	(0.02)	(0.01)	(0.01)
Aerobic Capacity HFZ	0.358***	0.356***	0.290***	0.357***
	(0.03)	(0.03)	(0.02)	(0.02)
Upper Body HFZ	0.010	0.166***	0.083***	0.188***
	(0.03)	(0.03)	(0.02)	(0.03)
Abdominal HFZ	0.128***	0.258***	0.147***	0.201***
	(0.03)	(0.04)	(0.03)	(0.03)
Trunk Extensor Strength HFZ	-0.006	-0.003	0.092**	0.051
	(0.03)	(0.04)	(0.03)	(0.03)
Flexibility HFZ	0.025	0.036	0.041	0.111***
	(0.03)	(0.03)	(0.02)	(0.03)

Middle Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Body Composition HFZ	-0.023	0.058**	0.003	0.010
	(0.02)	(0.02)	(0.02)	(0.02)
School Size	-0.000***	-0.000***	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.652***	-0.475***	-0.753***	-0.486***
	(0.08)	(0.08)	(0.06)	(0.07)
Prior Percent Attendance	0.704***	0.699***	0.678***	0.676***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	29.941***	30.536***	32.999***	33.590***
	(1.00)	(1.05)	(0.80)	(0.80)
R^2	0.402	0.400	0.401	0.407
BIC	772,537	719,529	1,096,986	1,021,676
N	145,617	136,963	211,378	200,238

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-19. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and Attendance Rate, High Schools, 2014–15 and 2015–16

High Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-0.261***	-0.273***	-0.401***	-0.454***
	(0.07)	(0.06)	(0.03)	(0.04)

High Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Special Education	-0.072	-0.013	-0.137*	-0.173
	(0.09)	(0.12)	(0.06)	(0.09)
English language learner	-0.649***	-0.102	-0.559***	-0.466***
	(0.13)	(0.13)	(0.09)	(0.10)
Asian	0.457***	0.544***	0.481***	0.488***
	(0.12)	(0.11)	(0.07)	(0.07)
Black	-0.290*	-0.089	-0.135	-0.170*
	(0.12)	(0.11)	(0.08)	(0.08)
Hispanic	-0.204*	-0.227**	-0.122*	-0.081
	(0.08)	(0.07)	(0.05)	(0.06)
American Indian or Alaskan Native	0.351	-0.024	-0.252	0.052
	(0.25)	(0.36)	(0.25)	(0.20)
Pacific Islander	-1.107	0.796	-0.306	0.079
	(0.60)	(0.53)	(0.34)	(0.34)
Two or More	-0.145	-0.093	0.100	0.080
	(0.13)	(0.14)	(0.08)	(0.08)
Age	-0.494***	-0.485***	-0.379***	-0.375***
	(0.04)	(0.04)	(0.02)	(0.03)
Aerobic Capacity HFZ	0.289***	0.333***	0.330***	0.235***
	(0.06)	(0.05)	(0.04)	(0.04)
Upper Body HFZ	0.087	0.404***	0.081	0.318***
	(0.06)	(0.07)	(0.04)	(0.06)
Abdominal HFZ	0.392***	0.544***	0.319***	0.558***

High Schools	Attendance Rate			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.07)	(0.07)	(0.05)	(0.07)
Trunk Extensor Strength HFZ	0.246*	0.242	0.196*	0.249
	(0.12)	(0.15)	(0.08)	(0.13)
Flexibility HFZ	-0.010	0.087	-0.030	0.159**
	(0.07)	(0.07)	(0.04)	(0.06)
Body Composition HFZ	-0.075	-0.055	-0.070*	-0.078
	(0.05)	(0.05)	(0.03)	(0.04)
School Size	-0.000*	-0.000**	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-1.157***	-0.914***	-1.088***	-1.096***
	(0.29)	(0.26)	(0.18)	(0.18)
Prior Percent Attendance	0.815***	0.774***	0.802***	0.759***
	(0.02)	(0.02)	(0.01)	(0.02)
Constant	24.765***	27.878***	24.857***	28.395***
	(1.82)	(1.71)	(1.21)	(1.66)
R^2	0.403	0.403	0.420	0.420
BIC	432,249	357,503	760,611	626,860
N	71,453	60,387	131,058	109,243

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-20. – Full Multivariate Change Model Results Between FitnessGram® HFZ Metrics and Attendance Rate

	Attendance Rate Difference	
Independent Variables	**Male**	**Female**
Asian	0.146***	0.145***
	(0.03)	(0.03)
Black	-0.081*	-0.079*
	(0.03)	(0.03)
Hispanic	-0.061*	-0.004
	(0.03)	(0.03)
American Indian or Alaskan Native	-0.181	-0.158
	(0.10)	(0.11)
Pacific Islander	0.202	-0.063
	(0.15)	(0.15)
Two or More	-0.053	0.121*
	(0.05)	(0.05)
Age	-0.141***	-0.150***
	(0.01)	(0.02)
School Size	-0.000*	-0.000
	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.485***	-0.460***
	(0.06)	(0.05)
Economic Disadvantage Increased	0.042	0.148***
	(0.04)	(0.04)
Economic Disadvantage Decreased	0.012	0.033
	(0.04)	(0.03)

	Attendance Rate Difference	
Independent Variables	**Male**	**Female**
Special Education	-0.070**	-0.077*
	(0.03)	(0.03)
English language learner	-0.067**	-0.044
	(0.02)	(0.02)
Aerobic Capacity Decreased	-0.149***	-0.122***
	(0.02)	(0.02)
Upper Body Strength Decreased	-0.141***	-0.173***
	(0.02)	(0.02)
Abdominal Strength Decreased	-0.145***	-0.185***
	(0.03)	(0.03)
Trunk Extensor Strength Decreased	-0.072**	-0.054*
	(0.03)	(0.03)
Flexibility Decreased	-0.038	-0.166***
	(0.03)	(0.03)
Aerobic Capacity Increased	0.147***	0.148***
	(0.03)	(0.02)
Upper Body Strength Increased	0.012	-0.009
	(0.02)	(0.02)
Abdominal Strength Increased	0.023	-0.043
	(0.02)	(0.03)
Trunk Extensor Strength Increased	-0.005	-0.017
	(0.02)	(0.03)
Flexibility Increased	-0.044	0.022
	(0.02)	(0.03)

	Attendance Rate Difference	
Independent Variables	**Male**	**Female**
Body Composition Changed	0.055**	0.022
	(0.02)	(0.02)
Constant	1.995***	2.033***
	(0.16)	(0.15)
R^2	0.012	0.011
BIC	1,337,840	1,231,508
N	253,972	239,162

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Obesity Models

Table C-21. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and Body Composition, 2015–16

	Body Composition	
	2015–16	
Independent Variables	**Male**	**Female**
Economically Disadvantaged	-0.003*	-0.006***
	(0.00)	(0.00)
Special Education	0.026***	0.013***
	(0.00)	(0.00)
English language learner	-0.006***	0.003
	(0.00)	(0.00)
Asian	0.016***	0.034***
	(0.00)	(0.00)

	Body Composition	
	2015–16	
Independent Variables	**Male**	**Female**
Black	-0.006**	-0.029***
	(0.00)	(0.00)
Hispanic	-0.027***	-0.024***
	(0.00)	(0.00)
American Indian or Alaskan Native	-0.011	-0.025**
	(0.01)	(0.01)
Pacific Islander	-0.032*	-0.046***
	(0.01)	(0.01)
Two or More	-0.011**	-0.017***
	(0.00)	(0.00)
Age	0.005***	0.003***
	(0.00)	(0.00)
Aerobic Capacity HFZ	0.125***	0.113***
	(0.00)	(0.00)
Upper Body HFZ	0.040***	0.036***
	(0.00)	(0.00)
Abdominal HFZ	0.021***	0.017***
	(0.00)	(0.00)
Trunk Extensor Strength HFZ	-0.038***	-0.031***
	(0.00)	(0.00)
Flexibility HFZ	0.041***	0.032***
	(0.00)	(0.00)
School Size	0.000	0.000***

	Body Composition	
	2015–16	
Independent Variables	**Male**	**Female**
	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.021***	-0.019***
	(0.00)	(0.00)
Prior Body Composition HFZ	0.375***	0.366***
	(0.00)	(0.00)
BIC	413,763	363,219
N	533,179	496,209

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-22. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and Body Composition, 2014–15 and 2015–16, No Lagged Dependent Variable

	Body Composition			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.012***	-0.027***	-0.009***	-0.018***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	0.052***	0.027***	0.058***	0.033***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.011***	0.009***	-0.012***	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.003	0.077***	0.008	0.081***
	(0.00)	(0.00)	(0.00)	(0.00)
Black	-0.029***	-0.082***	-0.023***	-0.073***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.100***	-0.077***	-0.087***	-0.072***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.082***	-0.045***	-0.055***	-0.044***
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	-0.101***	-0.097***	-0.103***	-0.102***
	(0.02)	(0.02)	(0.02)	(0.02)
Two or More	-0.023***	-0.050***	-0.026***	-0.047***
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.017***	0.011***	0.011***	0.009***
	(0.00)	(0.00)	(0.00)	(0.00)
Aerobic Capacity HFZ	0.218***	0.197***	0.277***	0.265***

	Body Composition			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Upper Body HFZ	0.130***	0.109***	0.103***	0.092***
	(0.00)	(0.00)	(0.00)	(0.00)
Abdominal HFZ	0.051***	0.059***	0.045***	0.049***
	(0.00)	(0.00)	(0.00)	(0.00)
Trunk Extensor Strength HFZ	-0.103***	-0.095***	-0.092***	-0.084***
	(0.00)	(0.00)	(0.00)	(0.00)
Flexibility HFZ	0.102***	0.086***	0.105***	0.086***
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0	0.000***	0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.081***	-0.079***	-0.056***	-0.051***
	(0.01)	(0.01)	(0.01)	(0.01)
BIC	624,474	576,183	780,787	705,704
N	516,660	483,710	671,568	621,823

Note: * $p<0.05$, ** $p<0.01$, *** $p<0.001$ Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Discipline Models

Table C-23. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and ISS Referrals, 2014–15 and 2015–16

	ISS Referrals			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	0.044***	0.028***	0.046***	0.033***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	0.017***	0.009***	0.018***	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.002	-0.009***	0.001	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.076***	-0.040***	-0.078***	-0.040***
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.069***	0.057***	0.063***	0.052***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.009***	0.005**	-0.017***	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	0.019*	0.005	-0.006	0.009
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	0.010	0.014	-0.007	0.012
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	0.021***	0.028***	0.022***	0.017***
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.011***	0.009***	0.010***	0.009***
	(0.00)	(0.00)	(0.00)	(0.00)

	ISS Referrals			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Aerobic Capacity HFZ	-0.010***	-0.015***	-0.010***	-0.015***
	(0.00)	(0.00)	(0.00)	(0.00)
Upper Body HFZ	0.002	-0.007***	0.002	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
Abdominal HFZ	-0.005*	-0.008***	-0.002	-0.007***
	(0.00)	(0.00)	(0.00)	(0.00)
Trunk Extensor Strength HFZ	-0.001	0.002	0.003	0.002
	(0.00)	(0.00)	(0.00)	(0.00)
Flexibility HFZ	-0.006***	-0.003*	-0.002	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
Body Composition HFZ	0.006***	0.001	0.006***	0.002
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000	0.000**	-0.000*	0.000*
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	0.044***	0.042***	0.053***	0.048***
	(0.01)	(0.01)	(0.01)	(0.00)
Prior ISS Referrals	0.216***	0.129***	0.211***	0.120***
	(0.00)	(0.00)	(0.00)	(0.00)
BIC	353,451	202,750	459,014	253,506
N	489,676	460,105	641,961	596,432

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-24. – Full Multivariate Model Results Between FitnessGram® HFZ Metrics and OSS Referrals, 2014–15 and 2015–16

	OSS Referrals			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	0.021***	0.014***	0.021***	0.013***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	0.018***	0.005***	0.016***	0.006***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	0.004**	-0.000	0.002	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.030***	-0.014***	-0.025***	-0.011***
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.063***	0.045***	0.059***	0.045***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	0.003	0.007***	-0.001	0.006***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	0.010	0.004	0.007	0.012**
	(0.01)	(0.00)	(0.00)	(0.00)
Pacific Islander	-0.001	0.003	0.001	0.002
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	0.022***	0.014***	0.017***	0.009***
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.007***	0.005***	0.005***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)
Aerobic Capacity HFZ	-0.010***	-0.008***	-0.008***	-0.008***

	OSS Referrals			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Upper Body HFZ	0.000	-0.004***	0.001	-0.003***
	(0.00)	(0.00)	(0.00)	(0.00)
Abdominal HFZ	-0.005***	-0.006***	-0.003**	-0.003***
	(0.00)	(0.00)	(0.00)	(0.00)
Trunk Extensor Strength HFZ	-0.002	-0.002	-0.002	-0.002
	(0.00)	(0.00)	(0.00)	(0.00)
Flexibility HFZ	-0.001	0.001	0.002	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Body Composition HFZ	0.006***	0.001*	0.004***	0.001*
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000	0.000*	0.000	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	0.077***	0.043***	0.077***	0.045***
	(0.01)	(0.00)	(0.00)	(0.00)
Prior OSS Referrals	0.122***	0.067***	0.108***	0.059***
	(0.00)	(0.00)	(0.00)	(0.00)
BIC	209,762	108,471	244,315	126,485
N	489,676	460,105	641,961	596,432

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Economic Disadvantaged Models

Table C-25. – Full Multivariate Model Results Between FitnessGram® Body Composition and Aerobic Capacity and Economic Disadvantaged Status, 2014–15 and 2015–16

	Body Composition		Aerobic Capacity	
	2015–16		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-0.006***	-0.015***	-0.016***	-0.046***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.009***	-0.017***	-0.081***	-0.103***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.008***	0.000	0.000	-0.011**
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	0.021***	0.040***	0.034***	0.044***
	(0.00)	(0.00)	(0.01)	(0.01)
Black	0.003	-0.027***	0.032***	-0.007
	(0.00)	(0.00)	(0.01)	(0.01)
Hispanic	-0.021***	-0.020***	0.018***	0.012**
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.016	-0.026***	0.001	0.003
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	-0.036**	-0.032**	0.043*	0.031
	(0.01)	(0.01)	(0.02)	(0.03)
Two or More	-0.006	-0.014***	0.033***	0.004
	(0.00)	(0.00)	(0.01)	(0.01)
Age	-0.001	0.001	-0.026***	-0.008***
	(0.00)	(0.00)	(0.00)	(0.00)

	Body Composition		Aerobic Capacity	
	2015–16		2015–16	
Independent Variables	Male	Female	Male	Female
School Size	0.000***	0.000***	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.058***	-0.056***	-0.176***	-0.190***
	(0.00)	(0.00)	(0.01)	(0.01)
Prior Body Composition HFZ	0.424***	0.407***		
	(0.00)	(0.00)		
Prior Aerobic Capacity HFZ			0.346***	0.355***
			(0.00)	(0.00)
BIC	504,809	438,634	343,233	336,300
N	607,808	563,184	316,600	293,343

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-26 – Full Multivariate Model Results Between FitnessGram® Upper Body and Abdominal Strength and Endurance and Economic Disadvantaged Status, 2014–15 and 2015–16

	Upper Body		Abdominal	
	2015–16		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-0.010***	-0.027***	-0.011***	-0.025***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.090***	-0.078***	-0.084***	-0.085***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.014***	-0.016***	-0.014***	-0.019***

	Upper Body		Abdominal	
	2015–16		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.021***	-0.018**	-0.005	-0.020**
	(0.01)	(0.01)	(0.01)	(0.01)
Black	0.041***	0.000	0.013***	-0.013***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.003	-0.007*	-0.009***	-0.022***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.023*	-0.020*	-0.021*	-0.023**
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	0.001	0.032*	0.018	0.033*
	(0.02)	(0.02)	(0.01)	(0.01)
Two or More	0.016***	0.009*	0.015***	0.003
	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.008***	0.010***	-0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000***	0.000***	0.000**	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.071***	-0.073***	-0.085***	-0.102***
	(0.01)	(0.01)	(0.01)	(0.01)
Prior Upper Body HFZ	0.274***	0.262***		
	(0.00)	(0.00)		
Prior Abdominal HFZ			0.202***	0.209***
			(0.00)	(0.00)

	Upper Body		Abdominal	
	2015–16		2015–16	
Independent Variables	Male	Female	Male	Female
BIC	611,854	575,246	571,892	540,668
N	615,362	570,410	634,057	586,246

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-27. – Full Multivariate Model Results Between FitnessGram® Trunk Extensor Strength and Flexibility and Economic Disadvantaged Status, 2014–15 and 2015–16

	Trunk Extensor Strength		Flexibility	
	2015–16		2015–16	
Independent Variables	Male	Female	Male	Female
Economically Disadvantaged	-0.002	-0.008***	-0.006***	-0.012***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.052***	-0.053***	-0.043***	-0.060***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.005	-0.013***	-0.011***	-0.008**
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.030***	-0.043***	0.019***	0.018***
	(0.01)	(0.01)	(0.00)	(0.00)
Black	-0.020***	-0.034***	0.008*	-0.006
	(0.01)	(0.00)	(0.00)	(0.00)
Hispanic	-0.016***	-0.017***	-0.020***	-0.009***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.009	-0.015	-0.010	-0.000

	Trunk Extensor Strength		Flexibility	
	2015–16		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	-0.011	-0.024	-0.010	-0.019
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	0.003	-0.012**	0.017***	0.005
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.022***	0.017***	0.005***	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	-0.000	-0.000	0.000*	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.036**	-0.039***	-0.039***	-0.064***
	(0.01)	(0.01)	(0.01)	(0.01)
Prior Trunk Extensor Strength HFZ	0.166***	0.152***		
	(0.00)	(0.00)		
Prior Flexibility HFZ			0.302***	0.267***
			(0.00)	(0.00)
BIC	513,032	416,227	610,702	494,460
N	604,208	561,432	627,551	582,643

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-28. – Full Multivariate Model Results Between FitnessGram® Body Composition and Economic Disadvantaged Status, 2014–15 and 2015–16, No Lagged Dependent Variable

	Body Composition			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.024***	-0.046***	-0.021***	-0.043***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.025***	-0.042***	-0.024***	-0.040***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.023***	-0.002	-0.023***	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	0.006	0.086***	0.008*	0.087***
	(0.00)	(0.00)	(0.00)	(0.00)
Black	-0.004	-0.078***	-0.004	-0.078***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.092***	-0.074***	-0.091***	-0.075***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.079***	-0.061***	-0.069***	-0.065***
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	-0.115***	-0.086***	-0.105***	-0.084***
	(0.02)	(0.02)	(0.02)	(0.02)
Two or More	-0.007	-0.041***	-0.009*	-0.044***
	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.001	0.001	-0.004***	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000***	0.000***	0.000***	0.000***

	Body Composition			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.145***	-0.152***	-0.154***	-0.152***
	(0.00)	(0.00)	(0.00)	(0.00)
BIC	1,422,174	1,274,825	1,196,485	1,078,547
N	1,079,742	1,002,281	909,449	846,805

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-29. – Full Multivariate Model Results Between FitnessGram® Aerobic Capacity and Economic Disadvantaged Status, 2014–15 and 2015–16, No Lagged Dependent Variable

	Aerobic Capacity			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.027***	-0.061***	-0.031***	-0.070***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.173***	-0.186***	-0.166***	-0.174***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.000	-0.010*	-0.003	-0.017***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	0.033***	0.045***	0.022**	0.036***
	(0.01)	(0.01)	(0.01)	(0.01)
Black	0.062***	-0.014*	0.034***	-0.031***
	(0.01)	(0.01)	(0.00)	(0.01)
Hispanic	0.029***	0.015**	0.014***	0.002
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.008	-0.013	-0.013	-0.018
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	0.018	0.017	-0.007	0.022
	(0.02)	(0.02)	(0.01)	(0.02)
Two or More	0.044***	0.017**	0.030***	-0.002
	(0.01)	(0.01)	(0.00)	(0.00)
Age	-0.043***	-0.045***	-0.030***	-0.022***
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000	0.000*	-0.000	-0.000

	Aerobic Capacity			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.220***	-0.261***	-0.275***	-0.280***
	(0.01)	(0.01)	(0.01)	(0.01)
BIC	700,723	687,017	1,010,190	971,428
N	568,273	528,510	797,000	734,381

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-30. – Full Multivariate Model Results Between FitnessGram® Upper Body Strength and Endurance and Economic Disadvantaged Status, 2014–15 and 2015–16, No Lagged Dependent Variable

	Upper Body			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.015***	-0.038***	-0.014***	-0.038***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.150***	-0.133***	-0.151***	-0.130***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.028***	-0.038***	-0.025***	-0.032***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.040***	-0.024**	-0.047***	-0.032***
	(0.01)	(0.01)	(0.01)	(0.01)
Black	0.058***	0.005	0.056***	0.003
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.012***	-0.014***	-0.009***	-0.013***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.024**	-0.032***	-0.039***	-0.027**
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	0.017	0.026*	0.022	0.033*
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	0.025***	0.013***	0.022***	0.007
	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.011***	0.007***	-0.010***	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000***	0.000***	0.000***	0.000***

	Upper Body			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.083***	-0.094***	-0.088***	-0.095***
	(0.01)	(0.01)	(0.01)	(0.01)
BIC	1,208,282	1,155,279	1,019,368	969,282
N	1,098,201	1,017,668	913,240	851,103

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-31. – Full Multivariate Model Results Between FitnessGram® Abdominal Strength and Endurance and Economic Disadvantaged Status, 2014–15 and 2015–16, No Lagged Dependent Variable

	Abdominal			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.017***	-0.039***	-0.016***	-0.034***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.118***	-0.124***	-0.123***	-0.124***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.024***	-0.030***	-0.020***	-0.028***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.018***	-0.022***	-0.018**	-0.027***
	(0.01)	(0.01)	(0.01)	(0.01)
Black	0.020***	-0.014***	0.012***	-0.021***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.015***	-0.029***	-0.016***	-0.032***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.015*	-0.037***	-0.021**	-0.035***
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	0.005	0.023	0.025*	0.031*
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	0.020***	0.002	0.016***	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.004***	-0.007***	-0.003***	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000**	0.000***	0.000***	0.000***

	Abdominal			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.097***	-0.123***	-0.102***	-0.126***
	(0.01)	(0.01)	(0.01)	(0.01)
BIC	1,046,305	1,000,436	926,505	880,782
N	1,100,108	1,018,774	939,005	874,385

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-32. – Full Multivariate Model Results Between FitnessGram® Trunk Extensor Strength and Economic Disadvantaged Status, 2014–15 and 2015–16, No Lagged Dependent Variable

	Trunk Extension			
	2014–15		2015–16	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.003**	-0.013***	-0.003*	-0.011***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.069***	-0.069***	-0.070***	-0.069***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.008***	-0.015***	-0.005	-0.014***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	-0.047***	-0.052***	-0.043***	-0.051***
	(0.01)	(0.01)	(0.01)	(0.01)
Black	-0.023***	-0.045***	-0.023***	-0.040***
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.020***	-0.019***	-0.018***	-0.018***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.009	-0.015*	-0.010	-0.021**
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	-0.036**	-0.037***	-0.018	-0.024*
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	-0.007*	-0.013***	0.000	-0.010**
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.000	-0.001	0.005***	0.001
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000***	0.000**	0.000	0.000*

	Trunk Extension			
	2014–15		2015–16	
Independent Variables	Male	Female	Male	Female
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.030**	-0.046***	-0.032**	-0.039***
	(0.01)	(0.01)	(0.01)	(0.01)
BIC	885,683	721,026	771,667	629,856
N	1,068,574	993,567	903,923	844,716

Note: * $p<0.05$, ** $p<0.01$, *** $p<0.001$ Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Table C-33. – Full Multivariate Model Results Between FitnessGram® Flexibility and Economic Disadvantaged Status, 2014–15 and 2015–16, No Lagged Dependent Variable

	Flexibility			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
Economically Disadvantaged	-0.012***	-0.021***	-0.011***	-0.020***
	(0.00)	(0.00)	(0.00)	(0.00)
Special Education	-0.087***	-0.111***	-0.083***	-0.106***
	(0.00)	(0.00)	(0.00)	(0.00)
English language learner	-0.022***	-0.028***	-0.026***	-0.025***
	(0.00)	(0.00)	(0.00)	(0.00)
Asian	0.016***	0.021***	0.017***	0.024***
	(0.00)	(0.00)	(0.00)	(0.00)
Black	0.008*	-0.005	0.011**	-0.008*
	(0.00)	(0.00)	(0.00)	(0.00)
Hispanic	-0.043***	-0.027***	-0.040***	-0.021***
	(0.00)	(0.00)	(0.00)	(0.00)
American Indian or Alaskan Native	-0.032***	-0.028***	-0.017*	-0.025**
	(0.01)	(0.01)	(0.01)	(0.01)
Pacific Islander	-0.016	-0.023*	-0.023	-0.018
	(0.01)	(0.01)	(0.01)	(0.01)
Two or More	0.015***	0.001	0.022***	0.009*
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.011***	0.003**	0.012***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)
School Size	0.000***	-0.000*	0.000***	-0.000*

	Flexibility			
	2014–15		**2015–16**	
Independent Variables	**Male**	**Female**	**Male**	**Female**
	(0.00)	(0.00)	(0.00)	(0.00)
Campus Avg. Economically Disadvantaged	-0.037***	-0.070***	-0.058***	-0.091***
	(0.01)	(0.01)	(0.01)	(0.01)
BIC	1,229,327	1,018,004	1,073,192	890,373
N	1,084,415	1,007,175	938,337	874,757

Note: * p<0.05, ** p<0.01, *** p<0.001 Estimates for the White students category are excluded because they are the base (reference) category and all coefficients for other race/ethnicity groups are in comparison with White students.

Source: FitnessGram® data, 2014–15 and 2015–16; Texas Education Agency data, 2014–15 and 2015–16; Public Education Information Management System, 2014–15 and 2015–16, Texas Education Agency.

Appendix D – References

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