Overview and Summary of Key Findings

The promotion of physical activity and physical fitness in youth is important to reduce the risk of chronic diseases later in life. There is also increasing evidence to support associations between physical activity / physical fitness and indicators of academic achievement. This report summarizes associations between health-related physical fitness and academic achievement using three years of data from the Texas Education Association. The focus of these analyses was on two specific health-related fitness assessments [aerobic capacity (AC) and body composition (BC)]. The associations were examined using two different analytic techniques to provide a more comprehensive evaluation.

Spearman correlations were computed by age, gender and year to examine the overall relationships with academic achievement. The associations varied by fitness test and academic test (as well as by gender and grade). Partial correlations controlling for key school level factors (socio-economic status, percent minority, and school enrollment) revealed weak correlations (i.e., < 0.20) for most comparisons. Consistent with previous findings, the associations were strongest in middle school students (6th to 8th graders). Stronger associations were generally found for body composition, compared to aerobic capacity. When results were stratified by level of HFZ achievement (low, medium and high), schools with high levels of HFZ achievement tended to have higher levels of academic achievement but results again varied by test, grade and age. Overall, body composition had a stronger association with math achievement and associations were stronger in middle school grades than elementary grades. Similar analysis was applied to data from 2011 and 2012 to evaluate the impact of fitness achievement on school attendance. AC had moderate associations with attendance, even after controlling for several confounders. When results were stratified by level of AC HFZ achievement, schools with high levels of HFZ tended to have higher attendance rates. No association was found between BC and attendance.

The results of the analyses provide continued evidence supporting links between health-related fitness and academic achievement (as well as modest associations with attendance)\textsuperscript{1}. However, the varied relationships make it difficult to draw definitive conclusions. Additional research with individual measures offers potential to better understand the relationships.

\textsuperscript{1} Relationships with student delinquency are currently being analyzed but strong associations are not expected.
Contents

Methods and Results ......................................................................................................................... 4

2011 Results .................................................................................................................................. 10

Spearman Correlations with Academic Achievement (TAKS) .................................................... 10

Figure 1. Spearman Correlations with TAKS Achievement—Girls ........................................ 10
Figure 2. 2011 Spearman (Partial) Correlations with TAKS Achievement—Girls ..................... 11
Figure 3. 2011 Spearman Correlations with TAKS Achievement—Boys ..................................... 12
Figure 4. 2011 Spearman (Partial) Correlations with TAKS Achievement — Boys .................. 13

Academic Achievement Stratified by Fitness Level ...................................................................... 14

Figure 5. 4th Grade Results ........................................................................................................ 14
Figure 6. 5th Grade Results ........................................................................................................ 15
Figure 7. 6th Grade Results ....................................................................................................... 16
Figure 8. 7th Grade Results ....................................................................................................... 17
Figure 9. 8th Grade Results ....................................................................................................... 18

2012 Results (STAAR) .................................................................................................................... 19

Spearman Correlations with Academic Achievement (STAAR) .................................................. 19

Figure 10. 2012 Spearman Correlation with STAAR - girls ....................................................... 19
Figure 11. 2012 Spearman (Partial) Correlations with STAAR — Girls ................................... 20
Figure 12. 2012 Spearman Correlations with STAAR — Boys .................................................. 21
Figure 13. 2012 Spearman (Partial) Correlation with STAAR — Boys ...................................... 22

Academic Achievement Stratified by Fitness Level – STAAR ................................................... 23

Figure 14. 4th Grade Results ...................................................................................................... 23
Figure 15. 5th Grade Results ..................................................................................................... 24
Figure 16. 6th Grade Results ..................................................................................................... 25
Figure 17. 7th Grade Results ..................................................................................................... 26
Figure 18. 8th Grade Results ..................................................................................................... 27

2013 – Results (STAAR) ............................................................................................................... 28

Spearman Correlations with Academic Achievement (STAAR) .................................................. 28

Figure 19. 2013 Spearman Correlations with STAAR – Girls ..................................................... 28
Figure 20. 2013 Spearman (Partial) Correlations with STAAR — Girls .................................... 29
Figure 21. 2013 Spearman Correlations with STAAR — Boys ................................................... 30
Association between Fitness and Academic Achievement

Figure 22. 2013 Spearman (Partial) Correlations with STAAR — Boys ........................................... 31
Academic Achievement Stratified by Fitness Level - STAAR ............................................................... 32
Figure 23. 4th Grade Results .................................................................................................................. 32
Figure 24. 5th Grade Results .................................................................................................................. 33
Figure 25. 6th Grade Results .................................................................................................................. 34
Figure 26. 7th Grade Results .................................................................................................................. 35
Figure 27. 8th Grade Results .................................................................................................................. 36
2011 Results (Attendance) ..................................................................................................................... 37
Attendance Stratified by Aerobic Fitness Level ....................................................................................... 37
Figure 28. .............................................................................................................................................. 37
2012 Results (Attendance) ..................................................................................................................... 38
Attendance Stratified by Aerobic Fitness Level ....................................................................................... 38
Figure 29. .............................................................................................................................................. 38
2013 Results (Attendance) ..................................................................................................................... 39
Attendance Stratified by Aerobic Fitness Level ....................................................................................... 39
Figure 30. .............................................................................................................................................. 39
Methods and Results

The data from the Texas Youth Fitness Project make it possible to systematically examine health-related fitness and links with academic achievement in the state of Texas. This report summarizes the associations between two specific health-related fitness assessments (Aerobic Capacity-AC and Body Composition-BC) and two academic assessments (math and reading) for three different years of data collected by the Texas Education Association (2010/2011, 2011/2012, and 2012/2013). The fitness data were screened using established procedures to ensure that results from individual schools provided generalizable results by both grade and gender.² This resulted in a sample of 2,761 elementary schools and 1,530 middle schools in 2011, 2,749 elementary schools and 1,173 middle schools in 2012, and 2,532 elementary and 1,073 middle schools in 2013 included in the final data set. The association between AC, BC and attendance was also studied with data from 2011 and 2012. A similar analytical approach was applied to fitness and attendance data.

The evaluation focused on the associations between percent of students that achieved the established FITNESSGRAM Healthy Fitness Zone® (HFZ) with the percent of students that achieved Level II Satisfactory--Phase-in 1 for the reading and math standards test. The TAKS test was administered to students in 2011, while the STAAR test was used for the majority of students in 2012 and 2013. Though the tests are similar, direct comparisons of achievement between the two tests should not be made. Student achievement from 4th to 8th grade were included in this report, as there were available grade level data on both academic achievement and physical fitness (e.g., 5th grade math and reading with 5th grade aerobic capacity and body composition). The “End of Course” (EOC) exam data from the STAAR test are available for students in grades 9th to 12th grade. However, students take EOC exams based on curriculum that has been completed rather than identified grade level (e.g., 9th and 10th grade students could take English I). Due to the inability to directly link academic and fitness data by grade, analyses of associations between academic and fitness data were not completed for grades 9th to 12th grade.

Two specific analyses were conducted for each year of data. One set of analyses examined correlations between % of youth achieving the age specific HFZ and the % of youth achieving the age specific academic standards. Spearman correlations were used to deal with data that was not normally distributed. Analyses were conducted with and without controlling for other school level factors in order to determine the impact of these variables on the results. The “partial” correlations that control for school level variables provide a more appropriate (and more conservative) view of the associations since it removes shared variance due to factors such as socio-economic status.

The other set of analyses used more sophisticated general linear models to examine the relationship between health-related fitness and academic achievement. For these analyses, both AC and BC were categorized into tertiles (i.e., high, medium, and low AC and BC achievement groups), respectively. Least square means of math and reading achievement were reported by three fitness levels after adjusting for the school demographic characteristics (i.e., SES, minority rate, and school size). These analyses provide

² Methods used to screen the data were summarized in a separate report documenting the levels and patterns of health-related fitness achievement based on the 2011, 2012 and 2013 FITNESSGRAM data.
more easily interpretable findings since they directly compare schools with high, medium and low levels of school level fitness achievement on indicators of academic achievement.

Some key summaries are below:

i. **Fitness Associations with Math, Reading**

1. **Results from Spearman Correlation Analyses:**

   Spearman correlations were computed by age, gender and year to examine the overall relationships. The association between health-related fitness and academic achievement varied by fitness test and academic test (as well as by gender and grade). Correlations were low to moderate with higher correlations generally noted for body composition (range: 0.17 to 0.48) than aerobic capacity (range: 0.11 to 0.39). Partial correlations controlling for key school levels factors (socio-economic status, percent minority, and school enrollment) reduced the correlations for both BC (range: 0.02 to 0.17) and AC (range: 0 to 0.16). This is not surprising since it is known that SES and other school characteristics can influence both health-related fitness and academic achievement. Associations were consistently higher for older middle school students (6th to 8th grade). Details on the findings for each year are summarized below:

   - **2011**
     - **Girls** (Figure 1 and 2): Spearman correlations ranged from 0.11 to 0.39 for AC and from 0.2 to 0.48 for BC (Figure 1). The corresponding ranges for the partial correlations were 0 to 0.12 and 0.06 to 0.19, respectively (Figure 2). Higher correlations were consistently reported for older youth.
     - **Boys** (Figure 3 and 4): Spearman correlations ranged from 0.12 to 0.45 for AC and from 0.17 to 0.45 for BC (Figure 3). The corresponding ranges for the partial correlations were 0 to 0.12 and 0.02 to 0.11, respectively (Figure 4). Higher correlations were consistently reported for older youth.

   - **2012**
     - **Girls** (Figure 10 and 11): Spearman correlations ranged from 0.18 to 0.39 for AC and from 0.26 to 0.48 for BC (Figure 10). The corresponding ranges for the partial correlations were 0.02 to 0.11 and 0.03 to 0.12, respectively (Figure 11). Higher correlations were consistently reported for older youth.
     - **Boys** (Figure 12 and 13): Spearman correlations ranged from 0.18 to 0.41 for AC and from 0.26 to 0.47 for BC (Figure 12). The corresponding ranges for the partial correlations were 0 to 0.14 and 0 to 0.09, respectively (Figure 13). Higher correlations were consistently reported for older youth.

   - **2013**
     - **Girls** (Figure 19 and 20): Spearman correlations ranged from 0.18 to 0.42 for AC and from 0.30 to 0.48 for BC (Figure 19). The corresponding ranges for the partial correlations were 0 to 0.08 and 0.08 to 0.17, respectively (Figure 20). Higher correlations were consistently reported for older youth.
2. Results from General Linear Models.

General Linear Models were used to compare schools with high, medium and low levels of
health-related fitness achievement. Results showed differences between high and low levels of
achievement but results again varied by test, grade and age. Specific findings for each year are
summarized below (separately for girls and boys).

In 2011, among girls
- Findings for Aerobic Capacity:
  - 4th, 6th and 7th grade girls who were in the high AC achievement schools had
    significantly higher math achievement rates than their peers from low AC
    achievement schools (Figures 5a, 7a, 8a, respectively).

- Findings for Body Composition (BC):
  - 5th, 6th and 7th grade girls who were in the high and medium BC achievement
    had significantly higher math and reading achievement rates than their peers
    from low BC achievement schools (Figure 6a and 7a, respectively).
  - 7th grade girls who were in the high BC achievement schools had significantly higher
    math and reading achievement rates than their peers from low BC achievement schools
    (Figure 8a).

In 2011, among boys.
- Findings for Aerobic Capacity (AC):
  - 6th and 8th grade boys who were in the high AC achievement schools had
    statistically significant higher math achievement rate than their peers from
    medium AC achievement schools (Figures 7b and 9b, respectively).
  - 8th grade boys who were in the high AC achievement schools had statistically
    significant higher math achievement rate than their peers from low AC
    achievement schools (Figure 9b).

- Findings for Body Composition (BC):
  - 6th grade boys who were in the high BC achievement schools had statistically
    significant higher math and reading achievement rate than their peers from low
    BC achievement schools (Figure 7b).
  - 8th grade boys who in the high BC achievement schools had statistically
    significant higher math achievement rate than their peers from medium BC
    achievement schools (Figure 9b).
In 2012, among girls

- Findings for Aerobic Capacity:
  - 8th grade girls who were in the high AC achievement schools had statistically significant higher math achievement rate than their peers from medium, and low AC achievement schools, respectively (Figure 18a).

- Findings for Body Composition (BC):
  - 5th to 8th grade girls who were in the high BC achievement schools had statistically significant higher math achievement rate than their peers from low BC achievement schools (Figures 15a, 16a, 17a, 18a).
  - 7th and 8th grade girls who were in the high BC achievement schools also had statistically significant higher math achievement rate than their peers from medium BC achievement schools (Figure 17a and 18a).

In 2012, among boys

- Findings for Aerobic Capacity:
  - 7th grade boys who were in the high AC achievement schools had statistically significant higher math achievement rate than their peers from medium AC achievement schools (Figures 17b).
  - 7th and 8th grade boys who were in the high AC achievement schools had statistically significant higher reading achievement rate than their peers from medium AC achievement schools (Figures 17b and 18b, respectively).
  - 7th grade boys who were in the medium AC achievement schools had statistically significant higher reading achievement rate than their peers from low AC achievement schools (Figure 17b).

- Findings for Body Composition (BC):
  - 6th and 7th grade boys who were in the medium BC achievement schools had statistically significant higher reading achievement rate than their peers from low BC achievement schools (Figure 16b and 17b).
  - 7th grade boys who were in the high BC achievement schools had statistically significant higher reading achievement rate than their peers from low BC achievement schools (Figure 17b).
  - 6th grade boys who were in the high BC achievement schools had statistically significant higher math achievement rate than their peers from low and medium BC achievement schools, respectively (Figure 16b).

In 2013, among girls

- Findings for Aerobic Capacity:
  - There were no significant achievement differences for any grades when stratified by AC achievement.

- Findings for Body Composition (BC):
Association between Fitness and Academic Achievement

- 4th and 6th grade girls who were in the medium BC achievement schools had statistically significant higher reading achievement rate than their peers from low BC achievement schools (Figure 23a and 25a).
- 5th and 7th grade girls who were in the high BC achievement schools had statistically significant higher reading achievement rate than their peers from low BC achievement schools (Figure 24a and 26a).
- 4th and 7th grade girls who were in the medium and high BC achievement schools had statistically significant higher math achievement rates than their peers from low BC achievement schools (Figure 23a and 26a).
- 8th grade girls who were in the high BC achievement schools had statistically significant higher math achievement rates than their peers from medium BC achievement schools (Figure 27a).

In 2013, among boys

- Findings for Aerobic Capacity:
  - 6th grade boys who were in the high AC achievement schools had statistically significant higher reading achievement rates than their peers from low AC achievement schools (Figure 25b).
  - 7th grade boys who were in the medium AC achievement schools had statistically significant higher reading achievement rates than their peers from low AC achievement schools (Figure 26b).

- Findings for Body Composition (BC):
  - 6th and 7th grade boys who were in the medium and high BC achievement schools had statistically significant higher reading achievement rates than their peers from low BC achievement schools (Figure 25b and 26b).
  - 6th grade boys who were in the high BC achievement schools had statistically significant higher math achievement rates than their peers from low BC achievement schools (Figure 25b).

ii. Fitness Associations with Attendance

1. **Results from Spearman Correlation Analysis**

Spearman correlations were computed by gender and year to examine the overall relationships. The association between health-related fitness and academic achievement varied by gender but were consistent across 2011 and 2013. Correlations were moderate between AC and attendance among boys (0.43 in 2011, 0.46 in 2012, and 0.43 in 2013) who tended to have higher correlations than girls (0.32 in 2011, 0.34 in 2012, and 0.32 in 2013) did. Partial correlations controlling for key school levels factors (socio-economic status, percent minority, and school enrollment) did not change the association for both boys (0.42 in 2011, 0.44 in 2012, and 0.42 in 2013) and girls (0.31 in 2011, 0.32 in 2012, and 0.31 in 2013).
2. Results from General Linear Models.
A significant association was only found in AC and attendance, thus General Linear Models were only used to compare schools with high, medium and low levels of AC health-related fitness achievement. Results showed that schools with higher AC health-related fitness achievement had significantly higher attendance rates. These patterns were consistent for both boys and girls. However, no patterns were evident when attendance was related to body composition.
2011 Results

Spearman Correlations with Academic Achievement (TAKS)

Figure 1. Spearman Correlations with TAKS Achievement—Girls

Aerobic Capacity

![Graph showing Spearman correlation between aerobic capacity and academic achievement by grade for girls.](image)

**Fig 1a.** Spearman correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

![Graph showing Spearman correlation between Body Composition and academic achievement by grade for girls.](image)

**Fig 1b.** Spearman correlation between Body Composition HFZ with Math and Reading achievement.
Figure 2. 2011 Spearman (Partial) Correlations with TAKS Achievement—Girls

Aerobic Capacity

Fig 2a. Spearman partial correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 2b. Spearman partial correlation between body composition HFZ with Math and Reading achievement.
Association between Fitness and Academic Achievement

Figure 3. 2011 Spearman Correlations with TAKS Achievement—Boys

Aerobic Capacity

Fig 3a. Spearman correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 3b. Spearman correlation between body composition HFZ with Math and Reading achievement.
Association between Fitness and Academic Achievement

Figure 4. 2011 Spearman (Partial) Correlations with TAKS Achievement — Boys

Aerobic Capacity

Fig 4a. Spearman partial correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 4b. Spearman partial correlation between body composition HFZ with Math and Reading achievement.
Academic Achievement Stratified by Fitness Level

Figure 5. 4th Grade Results

Fig 5a. 4th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 5b. 4th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Figure 6. 5th Grade Results

Fig 6a. 5th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 6b. 5th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Figure 7. 6th Grade Results

Fig 7a. 6th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 7b. 6th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$. 
Association between Fitness and Academic Achievement

Figure 8. 7th Grade Results

Fig 8a. 7th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 8b. 7th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$. 
Figure 9. 8th Grade Results

Fig 9a. 8th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 9b. 8th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Association between Fitness and Academic Achievement

2012 Results (STAAR)

Spearman Correlations with Academic Achievement (STAAR)

Figure 10. 2012 Spearman Correlation with STAAR - girls

Aerobic Capacity

Fig 10a. Spearman correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 10b. Spearman correlation between Body Composition HFZ with Math and Reading achievement.
Figure 11. 2012 Spearman (Partial) Correlations with STAAR — Girls

Aerobic Capacity

Fig 11a. Spearman partial correlation between aerobic capacity HFZ with Math and Reading achievement, respectively.

Body Composition

Fig 11b. Spearman partial correlation between body composition HFZ with Math and Reading achievement, respectively.
Figure 12. 2012 Spearman Correlations with STAAR — Boys

Aerobic Capacity

Fig 12a. Spearman correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 12b. Spearman correlation between body composition HFZ with Math and Reading achievement.
Figure 13. 2012 Spearman (Partial) Correlation with STAAR — Boys

Aerobic Capacity

Fig 13a. Spearman partial correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 13b. Spearman partial correlation between body composition HFZ with Math and Reading achievement.
Association between Fitness and Academic Achievement

Academic Achievement Stratified by Fitness Level – STAAR

Figure 14. 4th Grade Results

Fig 14a. 4th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).

Fig 14b. 4th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Figure 15. 5th Grade Results

Fig 15a. 5th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 15b. 5th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Association between Fitness and Academic Achievement

**Figure 16. 6th Grade Results**

Fig 16a. 6th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 16b. 6th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$. 
Association between Fitness and Academic Achievement

Figure 17. 7th Grade Results

Fig 17a. 7th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 17b. 7th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$. 

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Figure 18. 8th Grade Results

Fig 18a. 8th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: \( p < 0.0167 \).

Fig 18b. 8th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: \( p < 0.0167 \).
Association between Fitness and Academic Achievement

2013 – Results (STAAR)

Spearman Correlations with Academic Achievement (STAAR)

Figure 19. 2013 Spearman Correlations with STAAR – Girls

Aerobic Capacity

Fig 19a. Spearman correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 19b. Spearman correlation between Body Composition HFZ with Math and Reading achievement.
Figure 20. 2013 Spearman (Partial) Correlations with STAAR — Girls

Aerobic Capacity

Fig 20a. Spearman partial correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 20b. Spearman partial correlation between body composition HFZ with Math and Reading achievement.
Figure 21. 2013 Spearman Correlations with STAAR — Boys

Aerobic Capacity

Fig 21a. Spearman correlation between aerobic capacity HFZ with Math and Reading achievement.

Body Composition

Fig 21b. Spearman correlation between body composition HFZ with Math and Reading achievement.
**Figure 22. 2013 Spearman (Partial) Correlations with STAAR — Boys**

**Aerobic Capacity**

![Graph showing Spearman partial correlations between aerobic capacity HFZ with Math and Reading achievement.]

*Fig 22a. Spearman partial correlation between aerobic capacity HFZ with Math and Reading achievement.*

**Body Composition**

![Graph showing Spearman partial correlations between body composition HFZ with Math and Reading achievement.]

*Fig 22b. Spearman partial correlation between body composition HFZ with Math and Reading achievement.*
Association between Fitness and Academic Achievement

Academic Achievement Stratified by Fitness Level - STAAR

Figure 23. 4th Grade Results

Fig 23a. 4th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: \( p < 0.0167 \).

Fig 23b. 4th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Figure 24. 5th Grade Results

Fig 24a. 5th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 24b. 5th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
Figure 25. 6th Grade Results

Fig 25a. 6th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 25b. 6th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$. 
Figure 26. 7th Grade Results

Fig 26a. 7th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 26b. 7th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$. 
Association between Fitness and Academic Achievement

Figure 27. 8th Grade Results

Fig 27a. 8th grade girls Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right). * denotes statistically significant: $p < 0.0167$.

Fig 27b. 8th grade boys Academic Achievement stratified by Fitness Level-Aerobic Capacity (Left) and Body Composition (Right).
**2011 Results (Attendance)**

**Attendance Stratified by Aerobic Fitness Level**

Figure 28.

Fig 28. Attendance stratified by Aerobic Fitness Level-Aerobic Capacity by Girls (Left) and Boys (Right). * denotes statistically significant: $p < 0.0167$. 
Attendance Stratified by Aerobic Fitness Level

Figure 29.

Fig 29. Attendance stratified by Aerobic Fitness Level - Aerobic Capacity by Girls (Left) and Boys (Right). * denotes statistically significant: $p < 0.0167$. 
2013 Results (Attendance)

Attendance Stratified by Aerobic Fitness Level

Figure 30.

Fig 30. Attendance stratified by Aerobic Fitness Level-Aerobic Capacity by Girls (Left) and Boys (Right).
* denotes statistically significant: $p < 0.0167$. 