

Physical Fitness, Academic Achievement and Student Behavior Outcomes in Delaware Public Schools

December 2011

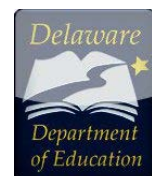


**Delaware Department of Education and
Nemours Health & Prevention Services**

Report prepared by:

Zhongcui Gao, MS and Marina Kaplan, PhD
(Nemours Health & Prevention Services)

John Ray, MS and Tony Ruggiero, MA
(Delaware Department of Education)



Acknowledgements

We gratefully acknowledge the contribution of the Delaware Department of Education and the Cooper Institute.

We are especially grateful to Kelli O. Thompson, JD, Director of NHPS' Policy, Evaluation and Research Department; Kathy Read, Human Kinetics FitnessGram[®] Director; and Lisa Marcum of Delaware Department of Education for their great support.

We gratefully acknowledge our colleagues from NHPS' Middle Childhood Team and NHPS' Policy, Evaluation and Research Department for their review of this report.

Table of Contents

INTRODUCTION	1
DATA DESCRIPTION	1
PURPOSE	2
RESULTS	2
Descriptive Statistics	3
Relationship between fitness levels and academic achievement	8
Relationship between fitness levels and days of suspension	11
Relationship between fitness levels and student attendance	13
LIMITATIONS	16
CONCLUSIONS	16
APPENDICES	
Appendix 1: FitnessGram [®] Recommended Tests Handout	17
Appendix 2: Delaware Department of Education Regulation 503 Physical Education Requirement	18
Appendix 3: The distribution of reading performance level by HFZ	19
Appendix 4: The distribution of math performance level by HFZ	20
REFERENCES	21

Physical Fitness, Academic Achievement and Student Behavior Outcomes in Delaware Public Schools

School Years (SY) 2008–09 and 2009–10

INTRODUCTION

Research suggests that one of the most significant factors contributing to the childhood obesity epidemic is a widespread lack of physical activity^{i ii iii}. Results from the Nemours Health & Prevention Services' (NHPS) 2008 Delaware Survey of Children's Health, parent reported data, suggest that 53.3% of children ages 6–17 and 49.7% of children ages 11–17 in public school were engaged in moderate to vigorous physical activity for at least 1 hour a day for 5 days per week^{iv}. However, student self-report surveys suggest that only 45% of children ages 11–17 were engaged in moderate to vigorous physical activity for at least 1 hour a day for 5 days per week (Delaware Youth Risk Behavior Surveillance Survey (YRBSS) 2007 and 2009^v).

Strong evidence exists which supports the link between physical activity and health outcomes,^{vi} as well as the positive effects of physical education and physical activity on school performance^{vii}. For example, several studies have found that providing increased time for physical activity can lead to better concentration, reduced disruptive behavior and higher tests scores in reading, math and writing^{viii} (Satcher, 2005). Despite this well-supported link, physical education programs in elementary and secondary schools have slowly been eroded during the past two decades.^{ix} Many educators and parents believe that spending time during school hours on physical activity is time that would be better spent on academic pursuits.^x These beliefs are contrary to research: A recent review concluded that academic learning per unit of class time is actually enhanced in physically active students.^{xi}

In addition, a cross sectional study completed by the California Department of Education matched Stanford Achievement Test Ninth Edition (SAT-9) standardized test scores with results of the state mandated, teacher administered physical fitness test known as the FitnessGram[®]. Results of the study suggest a “distinct and linear correlation between students' academic achievement and fitness scores” in all three grades. Higher academic performance was positively related to higher levels of fitness with the greatest academic gains seen in students who met three or more physical fitness standards.^{xii}

DATA DESCRIPTION

The Delaware Department of Education (DOE) and NHPS collaborated to analyze the relationships between Delaware student physical fitness levels as measured by FitnessGram[®] and student academic outcomes as measured by Delaware Student Testing Program (DSTP) scores, student attendance, and student behaviors as tracked by eSchoolPLUS (the electronic system used by DOE to enter and store student level data).

FitnessGram[®] is a health related fitness assessment tool developed by the Cooper Institute in 1982 for use in physical education programs^{xiii}. The tool uses health criterion-referenced standards, called Healthy Fitness Zones (HFZ), to define levels of physical fitness needed for good health. FitnessGram[®] assesses students via six tests corresponding with four areas: (1) aerobic capacity; 2) body composition; 3) muscular strength and endurance; 4) flexibility. For a detailed description of the tests, please see Appendix 1: FitnessGram[®] Recommended Tests Handout.

Delaware is one of a few states gathering fitness data on students using the FitnessGram 9.2[®], which is a web-based version of software managed by DOE to collect fitness data on public school students. DOE Regulation 503 for Physical Education (see Appendix 2) requires annual testing of and reporting on all students in grades 4, 7, 9/or10. Delaware has mandated five fitness tests:

- 1) **PACER** (aerobic capacity)
- 2) **Curl-up** (muscular strength and endurance)
- 3) **Trunk Lift** (muscular strength and endurance)
- 4) **Push-up** (muscular strength and endurance)
- 5) **Back-Saver Sit and Reach** (flexibility)

PURPOSE

The purpose of this study is to examine the association and relationships between students' physical fitness levels, DSTP scores (math and reading performance), attendance and discipline-related behaviors such as suspension rates while controlling for sex, race/ethnicity and other factors. The research questions are as follows:

- RQ#1: Is there an association between public school students' physical fitness levels and DSTP scores?
- RQ#2: Is there an association between public school students' physical fitness levels and reported discipline incidents?
- RQ#3: Is there an association between public school students' physical fitness levels and school attendance?

RESULTS

After merging FitnessGram[®] data and students' eSchoolPLUS data for SY 2008–09 and 2009–10, there were a total of 110,833 cases (59,389 for SY 2008–09; 51,444 for SY 2009–10). After a series of data cleaning and quality control steps were completed, the total number of usable cases dropped to 80,064. These data cleaning and quality control steps included dropping complete duplicates (9,215 cases) and then excluding those cases without all five mandated tests (20,457). Finally, for those students who took two or more tests within one school year, only the most recent record for that year was kept (1,097 cases dropped). A total of 39,370 cases for SY 2008-09 were taken from August 2008 through June 2009, and 40,694 cases for SY 2009–10 were taken from August 2009 through June 2010.

In addition, certain exclusions were applied to the analyses of the attendance and suspension variables. Specifically, cases with missing data are included only in those analyses where values are available for the variables being analyzed (i.e., cases are excluded from the analysis of variables where values are missing for those particular variables).

Descriptive Statistics

The demographic distributions for Delaware public school children with FitnessGram[®] data are similar for both SY 2008–09 and SY 2009–10 (see Table 1). As shown in Figure 1, the greatest numbers of students with FitnessGram[®] scores are in grades 4, 7, 9 and 10. This is not unexpected due to the DOE requirement of annual testing of and reporting on all students in grades 4, 7, 9/or10.

	SY 2008–09 (n=39,370)		SY 2009–10 (n=40,694)	
	N	(%)	N	(%)
Gender				
Female	19,077	(48.5%)	19,858	(48.8%)
Male	20,293	(51.5%)	20,836	(51.2%)
Race/ethnicity				
Hispanic	4,765	(12.1%)	4,348	(10.7%)
White	21,053	(54.5%)	22,463	(55.2%)
Black	12,259	(31.1%)	12,374	(30.4%)
Other	1,293	(3.3%)	1,507	(3.7%)
Missing	-	-	2	(0.0%)
SES				
Eligible for free or reduced lunch program (FRLP)	15,937	(40.5%)	16,723	(41.1%)
Non-eligible for FRLP	23,433	(59.5%)	23,971	(58.9%)

Table 1: The distribution of gender, race/ethnicity and the socioeconomic status (SES), SY 2008–09 and SY 2009–10

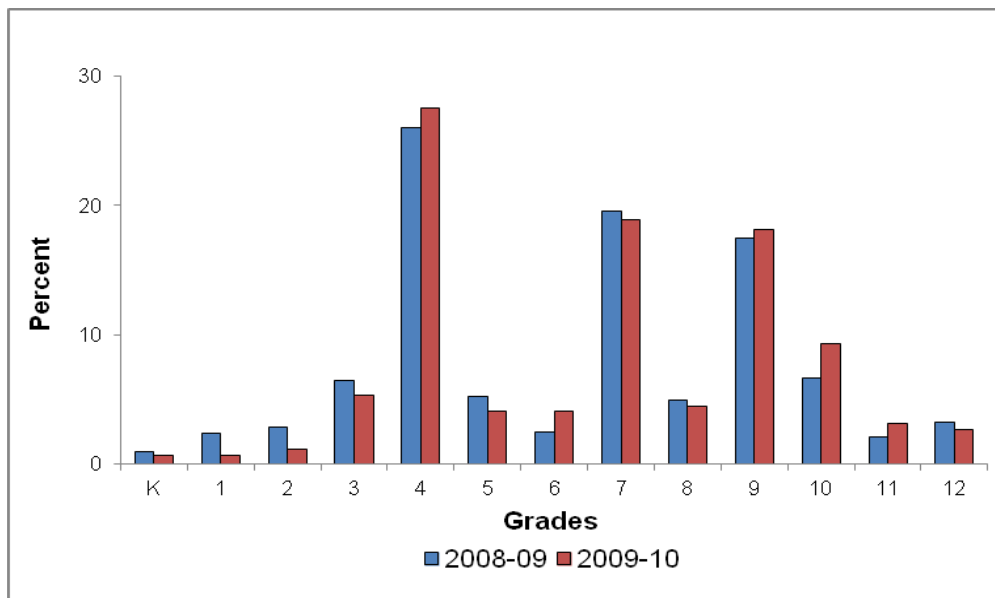


Figure 1: Student distribution by grade, SY 2008–09 (n=39,370) vs. SY 2009–10 (n=40,694)

Analysis of the distribution of students by number of tests classified in the HFZ suggests that for both SY 2008–09 and SY 2009–10, most students achieved three or more HFZ tests. Figure 2 and 3 show distributions of the number of HFZ by gender for each school year (Figure 2: SY 2008–09; Figure 3: SY 2009–10). The distributions are very similar in both years, and there were higher percentages of male students achieving four and five tests classified in the HFZ than females. For example, in SY 2008–09, 36.5% of male students achieved four out of five tests in the HFZ and 34.2% of female students achieved four tests in the HFZ. Also, in SY 2009–10, 11.1% male students achieved all five tests in HFZ and 9.3% female students achieved all five tests in HFZ.

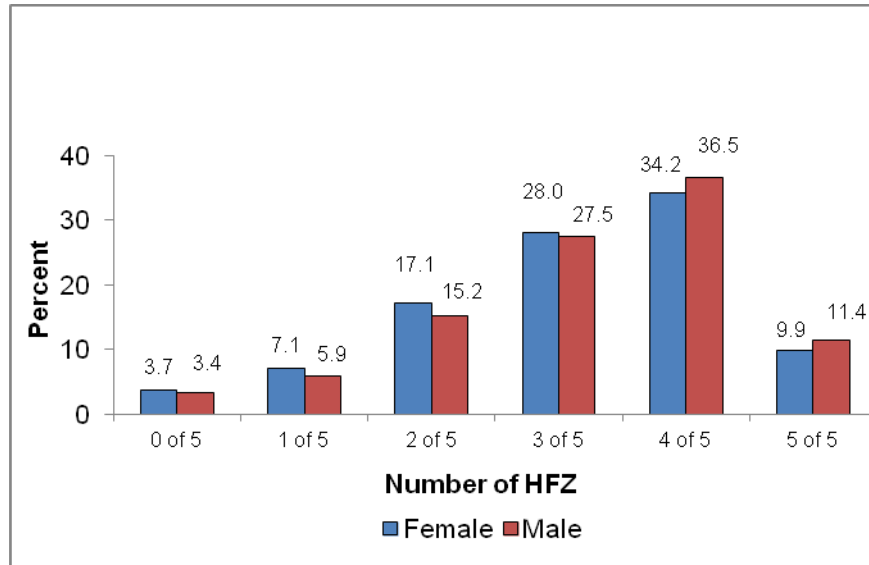


Figure 2: Distribution of HFZ by gender, SY 2008–09 (n=39,370)

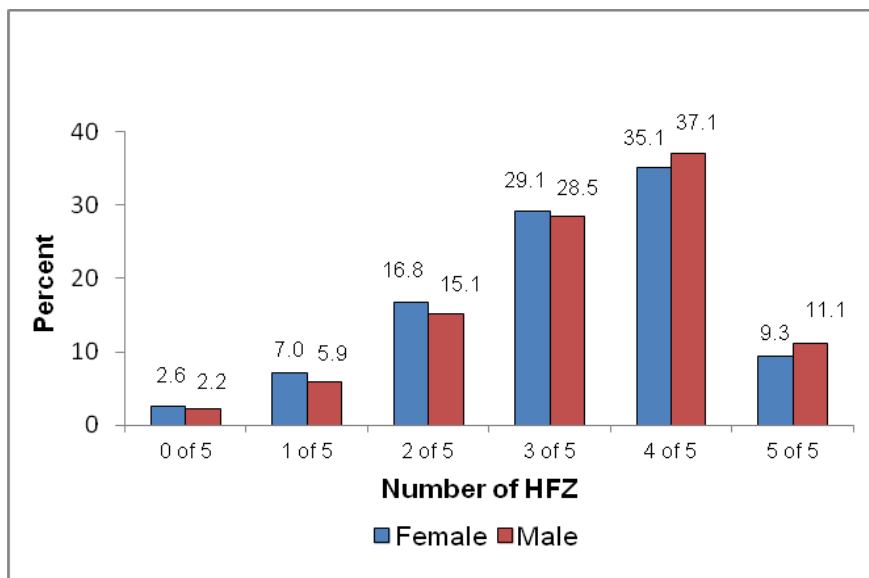


Figure 3: Distribution of HFZ by gender, SY 2009–10 (n=40,694)

Figures 4 and 5 show distributions of the number of HFZ tests achieved by the students' socioeconomic status (SES). SES was defined using the proxy measure of students meeting the requirements for the Free or Reduced Lunch Program (FRLP)^{xiv}. For both SY 2008–09 and SY 2009–10, the distributions for the number of tests in HFZ by SES are very similar. The students who were not in the FRLP program achieved higher percentages of four and five tests classified in the HFZ than students in the FRLP program. For example, in SY 2009–10, 38.5% of students who were not in the FRLP program achieved four tests in the HFZ, compared to 32.7% of students in the FRLP program.

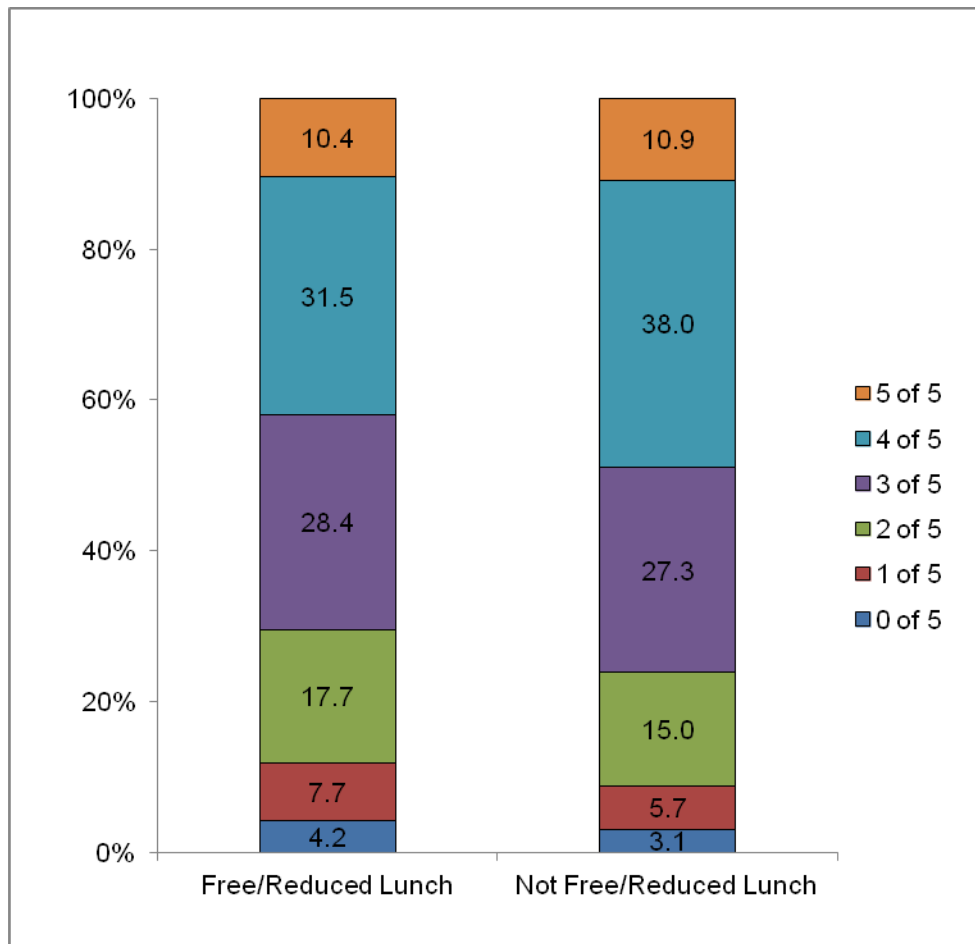


Figure 4: Distribution of HFZ by SES, SY 2008–09 (n=39,370)

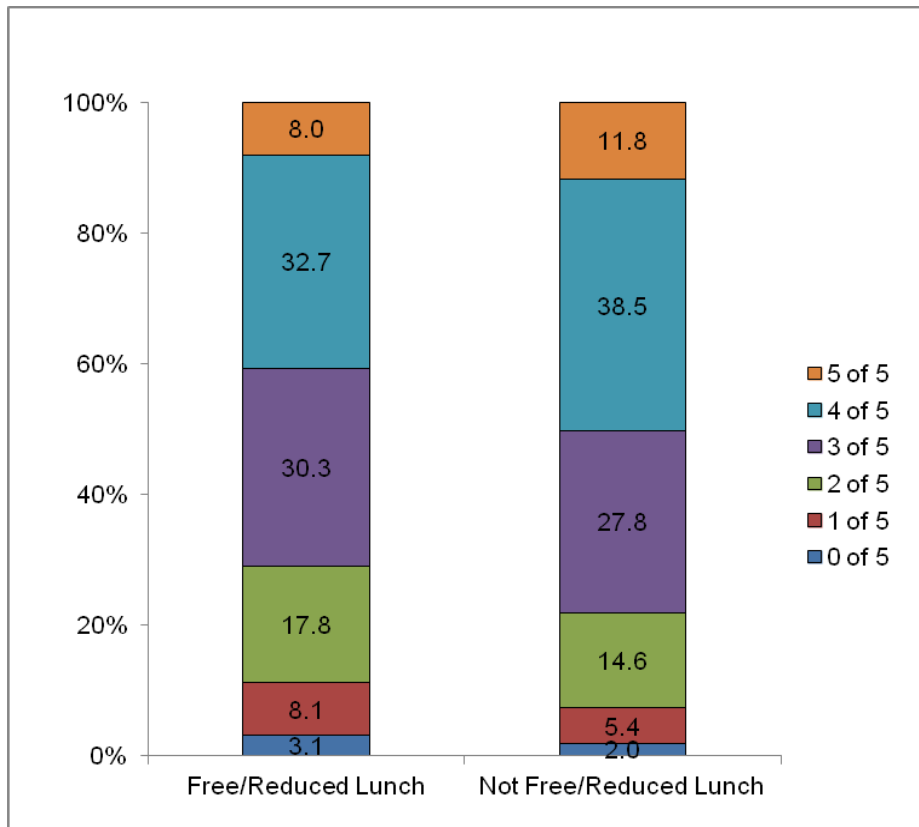


Figure 5: Distribution of HFZ by SES, SY 2009–10 (n=40,694)

Figures 6, 7, and 8 show the differences between SY 2008–09 and SY 2009–10 in number of HFZ achieved by students in grades 3–5, 6–8 and 9–10, respectively. Figure 6 indicates that for grades 3–5, the percentage of students achieving four and five tests in the HFZ decreased somewhat between SY 2008–09 and SY 2009–10, while the percentage of students achieving three tests in HFZ increased between SY 2009–09 and SY 2009–10. For example, 8.6% of students in grade 3–5 achieved five tests classified in the HFZ in SY 2008–09, but this percentage decreased to 7.3% in SY 2009–10.

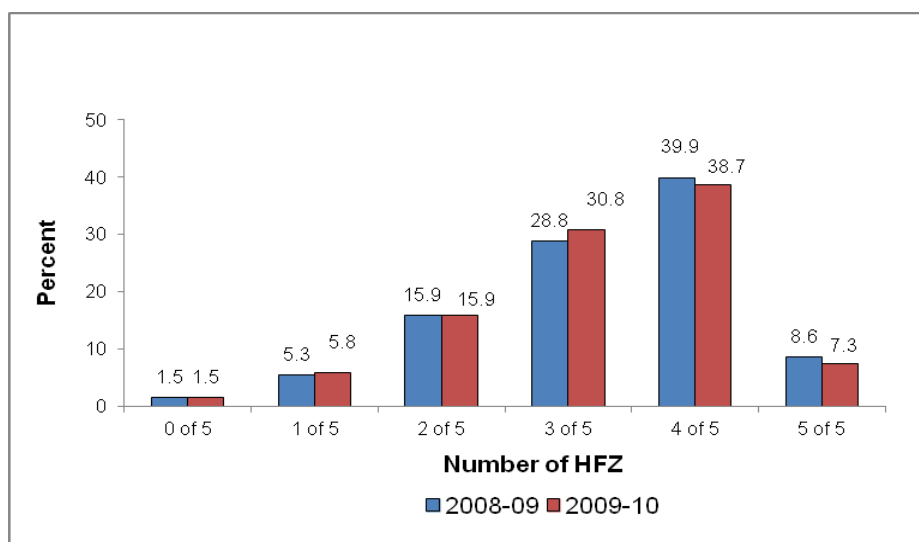


Figure 6: Distribution of HFZ for grades 3–5, SY 2008–09 (n=14,818) vs. SY 2009–10 (n=15,038)

Figure 7 shows that for grades 6–8, the percentage of students achieving four and five tests in the HFZ increased between SY 2008–09 and SY 2009–10. For example, the percentage of students achieving all five tests in the HFZ was 7.4% in SY 2008–09 and increased to 10.7% in SY 2009–10.

Figure 8 shows that for grade 9 and 10, the percentage of students achieving three, four and five tests in the HFZ increased between SY 2008–09 and SY 2009–10. For example, the percentage of students achieving all five tests in the HFZ increased from 9.9% to 10.4% between SY 2008–09 and SY 2009–10.

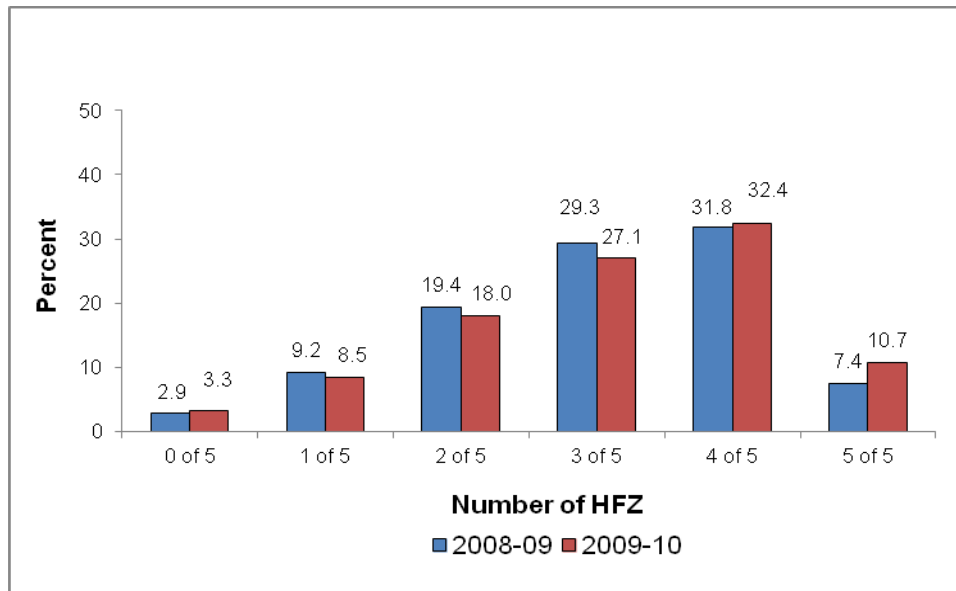


Figure 7: Distribution of HFZ for grades 6–8 (n=10,594), SY 2008–09 vs. SY 2009–10 (n=11,153)

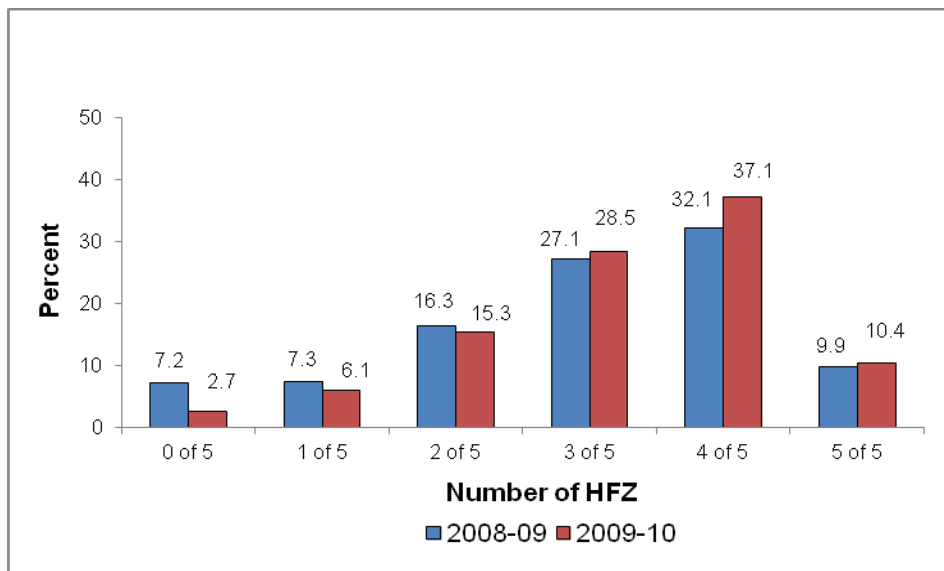


Figure 8: Distribution of HFZ for grades 9 & 10, SY 2008–09 (n=9,497) vs. SY 2009–10 (n=11,154)

Relationship between fitness level and academic achievement

The analysis shows a significant ($p \leq 0.05$) linear relationship between academic achievement scores and students' fitness levels after controlling for the students' gender, race, SES and school district. The relationship between academic achievement and fitness levels was similar for SY 2008–09 and SY 2009–10; thus, only figures representing data from SY 2009–10 are included in this report for purposes of brevity. Please note that DSTP reading and math performance levels were selected as the indicators for academic achievement. Although there are five DSTP performance levels, the two extreme performance levels “Distinguished” and “Well below the standard” were selected to display the relationship between academic achievement and fitness levels in the graphs below. The distributions for all five DSTP performance levels by the six different physical fitness levels for each grade (4,7, 9/10) are reported in Appendix 3 (reading performance) and Appendix 4 (math performance).

Figures 9 through 14 show that as fitness levels increase, the percentage of students achieving the “Distinguished” performance level for math and reading also increases; while the percentage of students in the “Well below the standard” category decreases. This is the case for all grades included in the analysis examining the relationship between academic achievement and fitness levels (grades 4, 7 and 9/10). The same is true for both reading and math performance, although the slopes are different, with 4th graders showing the steepest slopes.

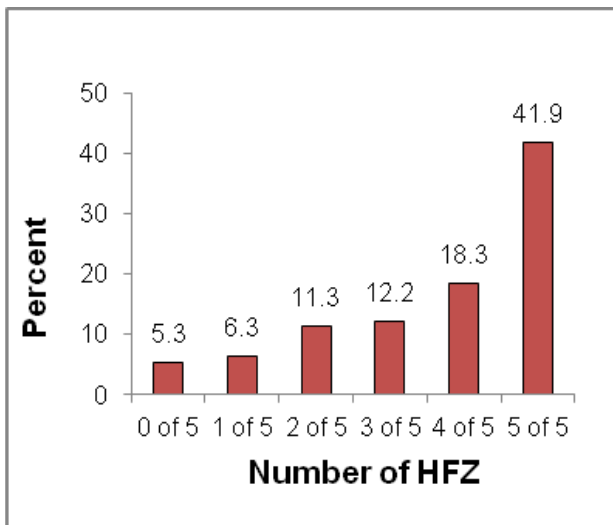


Figure 9a: Percentage of 4th grade students achieving “Distinguished” performance on DSTP reading test by fitness levels, SY 2009–10 (n=10,488)

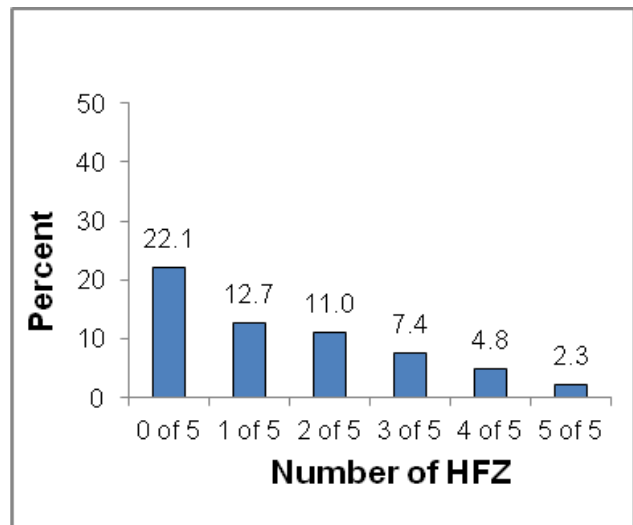


Figure 9b: Percentage of 4th grade students achieving “Well below the standard” performance on DSTP reading test by fitness levels, SY 2009–10 (n=10,488)

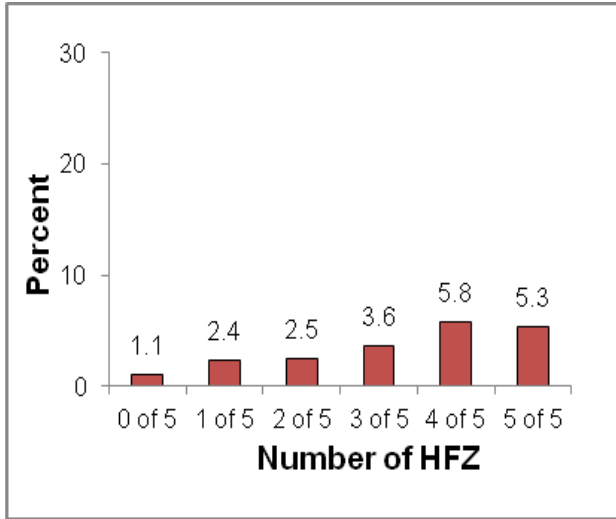


Figure 10a: Percentage of 7th grade students achieving “Distinguished” performance on DSTP reading test by fitness levels, SY 2009–10 (n=7,471)

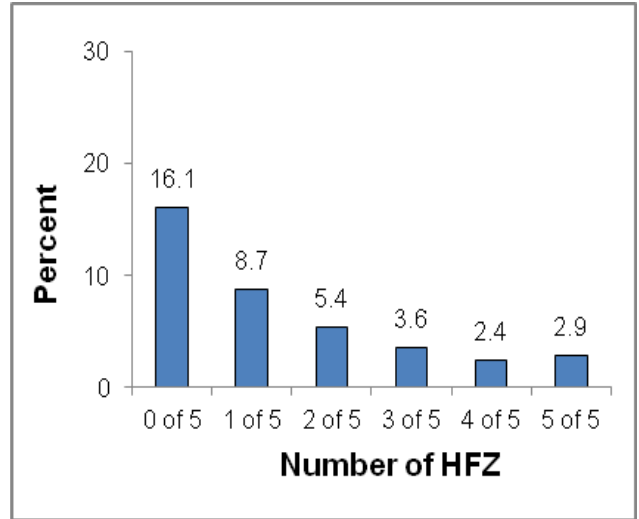


Figure 10b: Percentage of 7th grade students achieving “Well below the standard” performance on DSTP reading test by fitness levels, SY 2009–10 (n=7,471)

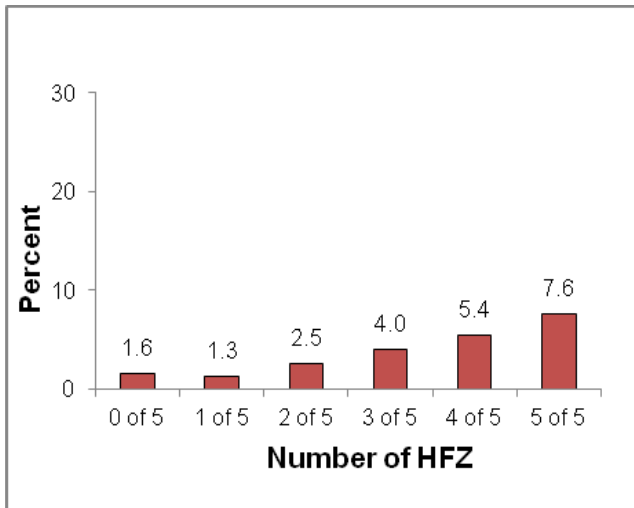


Figure 11a: Percentage of 9th & 10th grade students achieving “Distinguished” performance on DSTP reading test by fitness levels, SY 2009–10 (n=10,582)

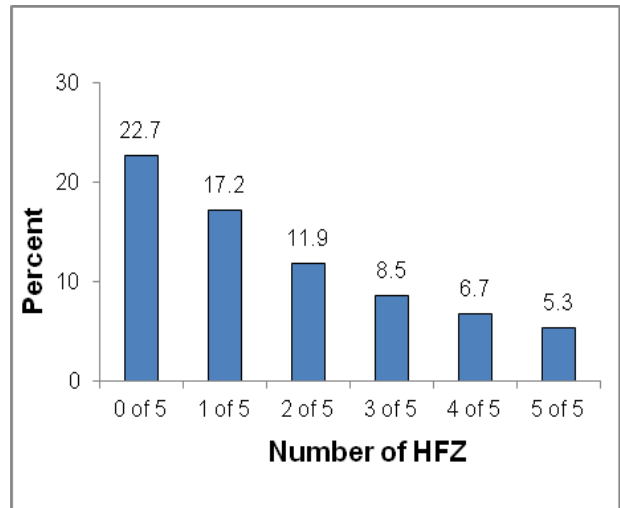


Figure 11b: Percentage of 9th & 10th grade students achieving “Well below the standard” performance on DSTP reading test by fitness levels, SY 2009–10 (n=10,582)

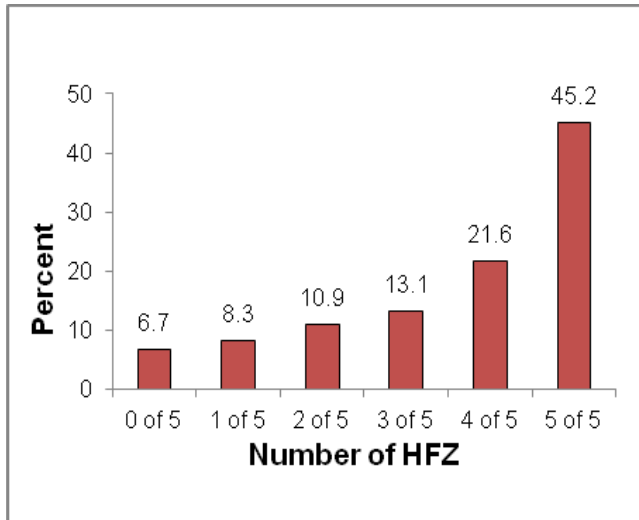


Figure 12a: Percentage of 4th grade students achieving “Distinguished” performance on DSTP math test by fitness levels, SY 2009–10 (n=10,811)

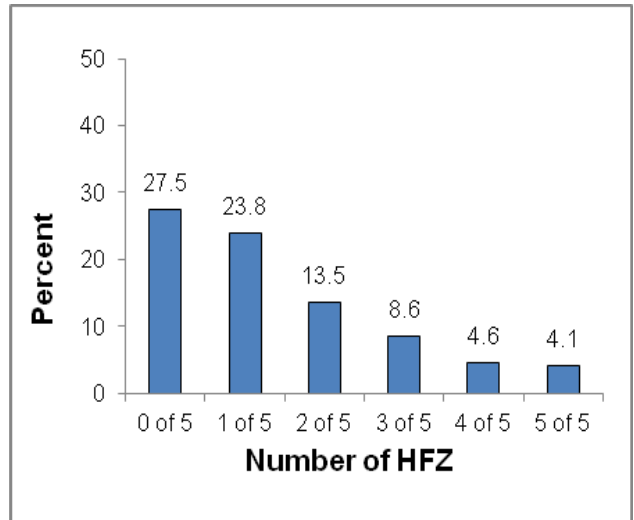


Figure 12b: Percentage of 4th grade students achieving “Well below the standard” performance on DSTP math test by fitness levels, SY 2009–10 (n=10,811)

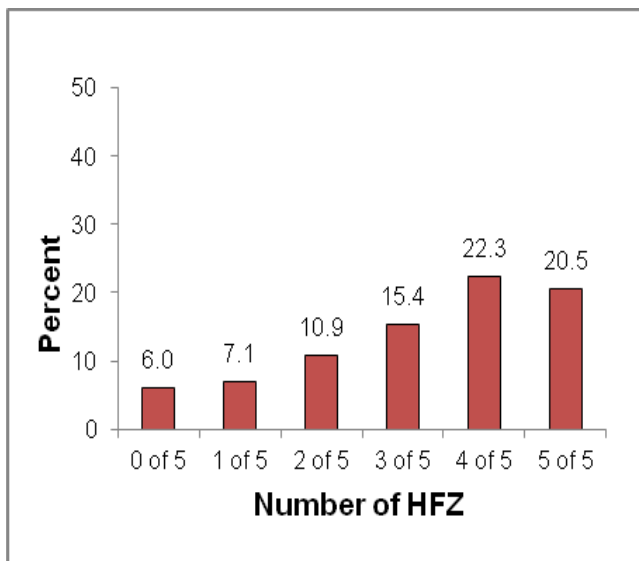


Figure 13a: Percentage of 7th grade students achieving “Distinguished” performance on DSTP math test by fitness levels, SY 2009–10 (n=7,525)

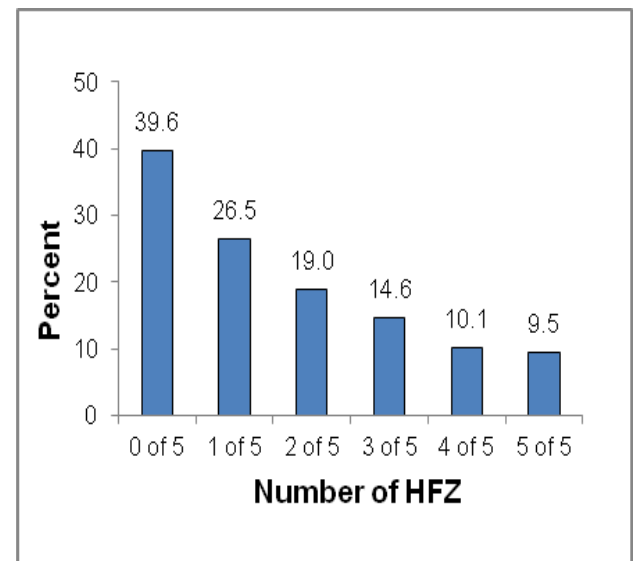


Figure 13b: Percentage of 7th grade students achieving “Well below the standard” performance on DSTP math test by fitness levels, SY 2009–10 (n=7,525)

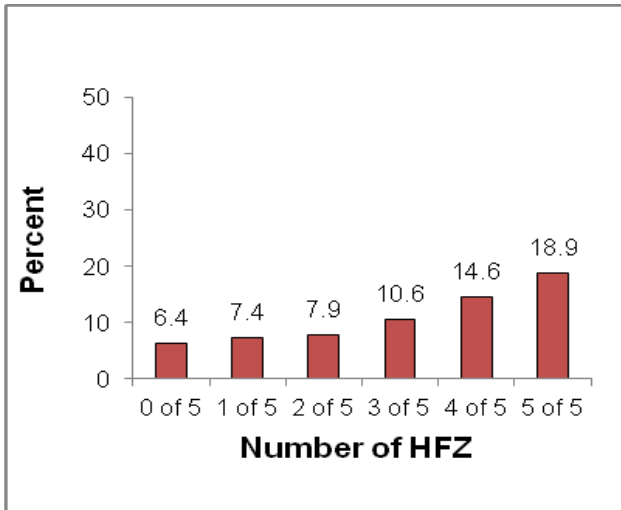


Figure 14a: Percentage of 9th & 10th grade students achieving “Distinguished” performance on DSTP math test by fitness levels, SY 2009–10 (n=10,688)

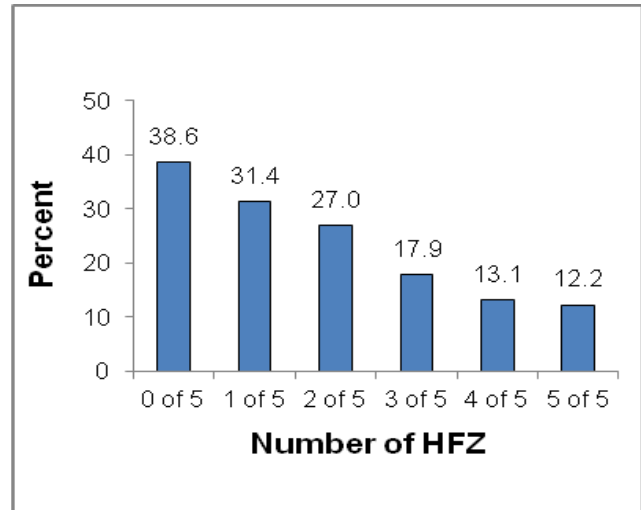


Figure 14b: Percentage of 9th & 10th grade students achieving “Well below the standard” performance on DSTP math test by fitness levels, SY 2009–10 (n=10,688)

Relationship between fitness levels and days of suspension

After controlling for the students’ school district, gender, race and SES, the data show significant differences ($p \leq 0.05$) in mean number of suspension days by fitness levels. Figures 15, 16 and 17 show this relationship at the state level. The first figure shows SY 2008–09 and SY 2009–10 combined in order to present the big picture. Figures 16 and 17 show grades 7 and grades 9/10, respectively, for SY 2009–10.

Figure 15 indicates that the average number of suspension days was 2.8 for those children who did not achieve any fitness tests in HFZ and 1.4 for students who achieved only one fitness test in the HFZ. However, the average number of suspension days was considerably less than one for students who achieved three or more tests in the HFZ.

Analysis of the relationship between mean suspension days and fitness levels for SY 2009–10 for grades 7 and 9/10 suggests that the mean number of days of suspension decreases as the number of tests in the HFZ increases (see Figures 16 and 17). Children who did not achieve any fitness tests in HFZ showed considerably higher suspension days than children who achieved one or more HFZ.

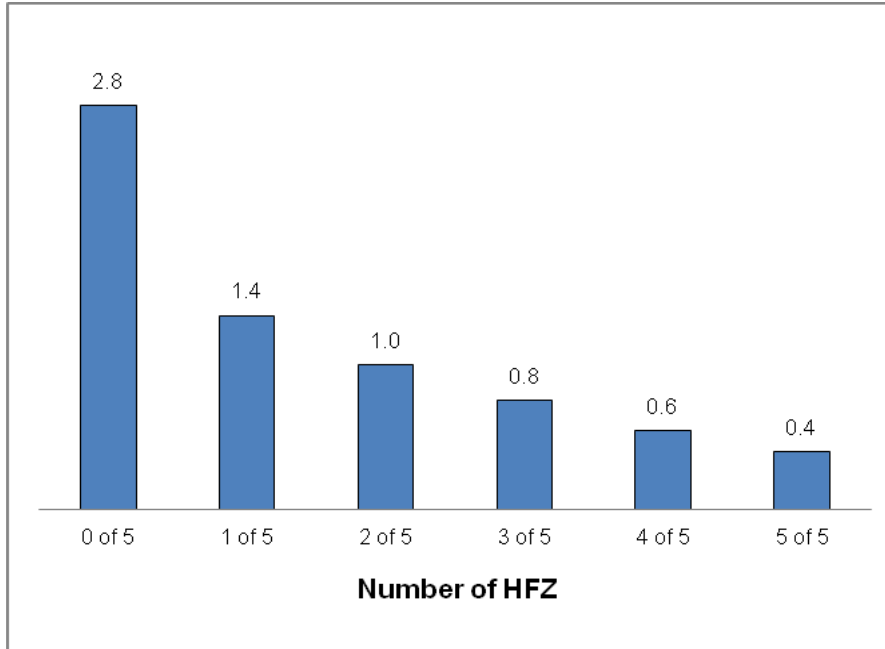


Figure 15: Mean suspension days by number of HFZ achieved for all grades combined, SY 2008-09 and 2009-10 (n=78,206)

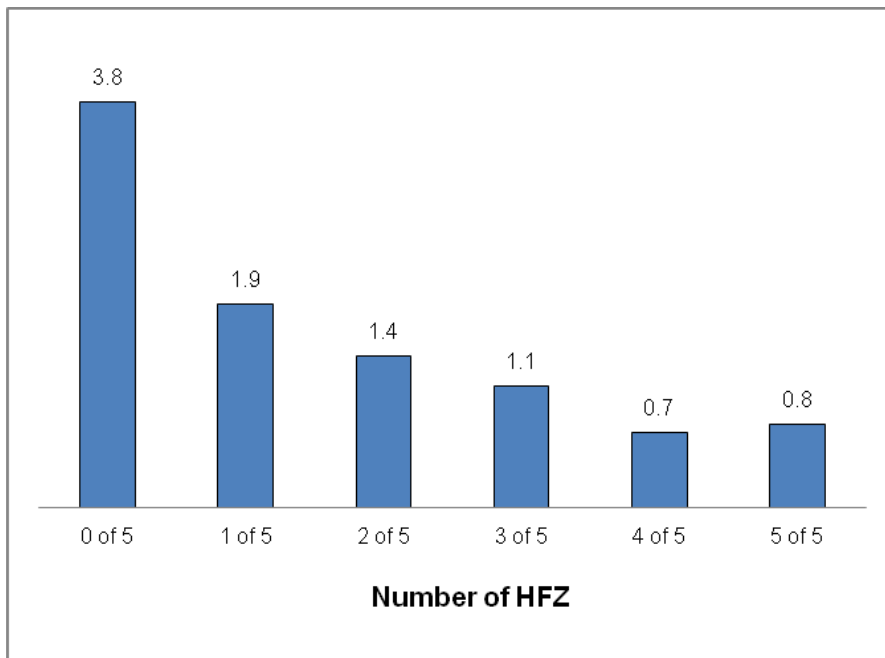


Figure 16: Mean suspension days by number of HFZ achieved for 7th grade students, SY 2009-10 (n=7,653)

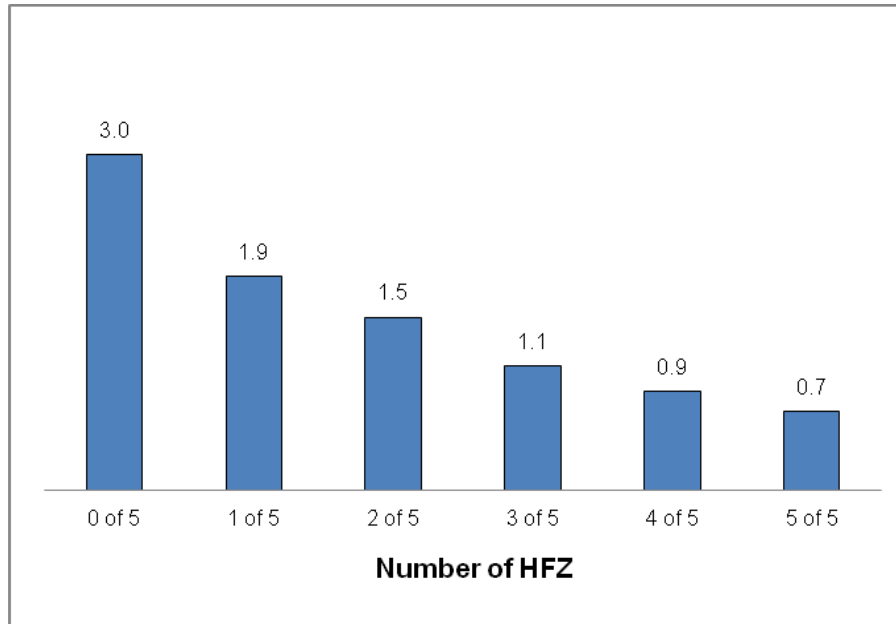


Figure 17: Mean suspension days by number of HFZ achieved for 9th & 10th grade students, SY 2009–10 (n=11,068)

Relationship between fitness levels and student attendance

Results show that there are significant differences ($p \leq 0.05$) in the mean number of attendance days by fitness levels after controlling for the students' gender, race, SES and school district.

Figure 18 shows that at the state level for both SY 2008–09 and SY 2009–10, mean attendance for those students who achieved no fitness tests in the HFZ was only 135 days. Students who achieved one fitness test in HFZ, however, had a mean attendance of 145 days. Those students who had at least four tests in the HFZ had an even greater mean attendance of 163 days.

A similar trend for the mean of attendance days holds true for students in grade 4, 7, and 9/10 in SY 2009–10: as the number of tests in the HFZ increases, so too does the mean student attendance (see Figures 19-21).

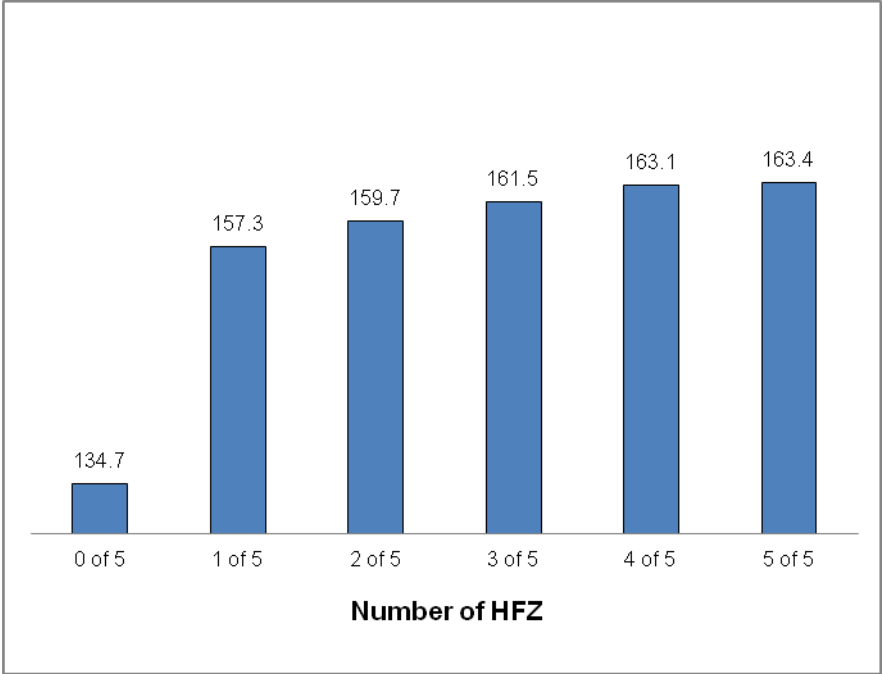


Figure 18: Mean attendance days by number of HFZ achieved combined for all grades, SY 2008–09 and SY 2009–10 (n=78,244)

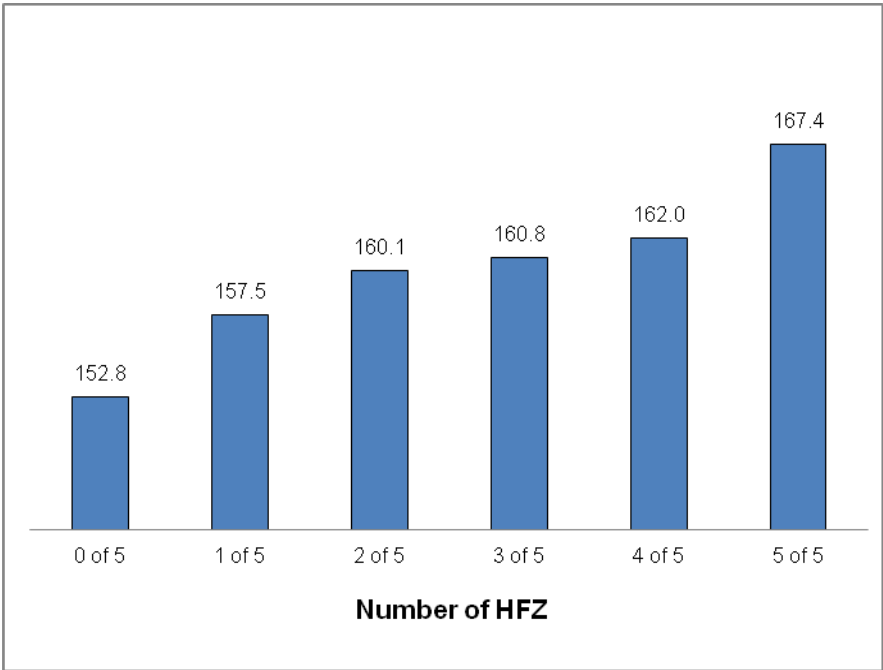


Figure 19: Mean attendance days by number of HFZ achieved for 4th grade students, SY 2009–10 (n=11,141)

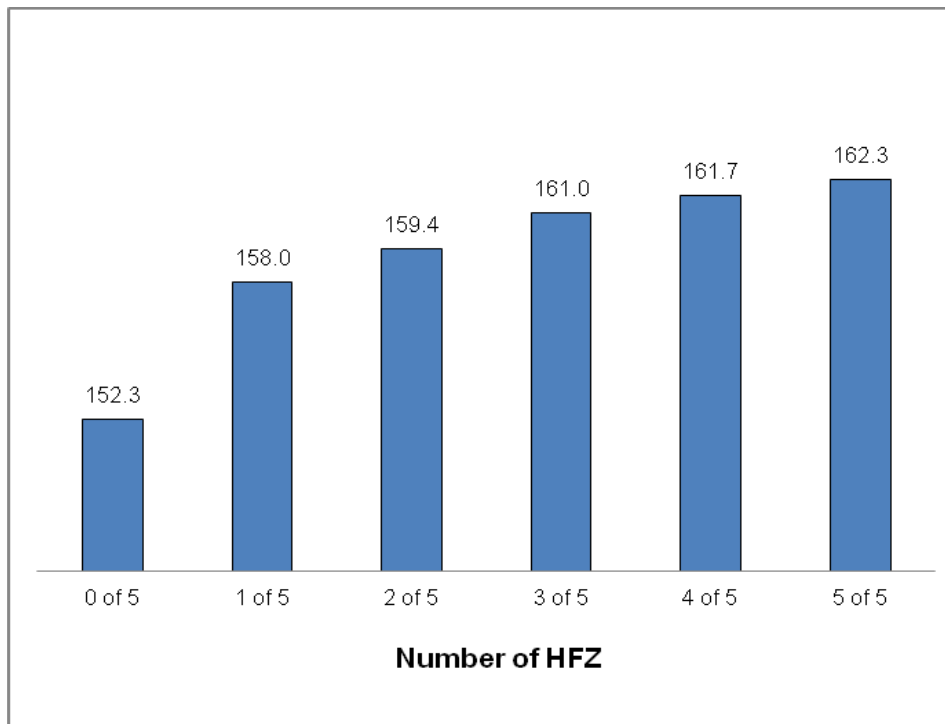


Figure 20: Mean attendance days by number of HFZ achieved for 7th grade students, SY 2009–10 (n=7,656)

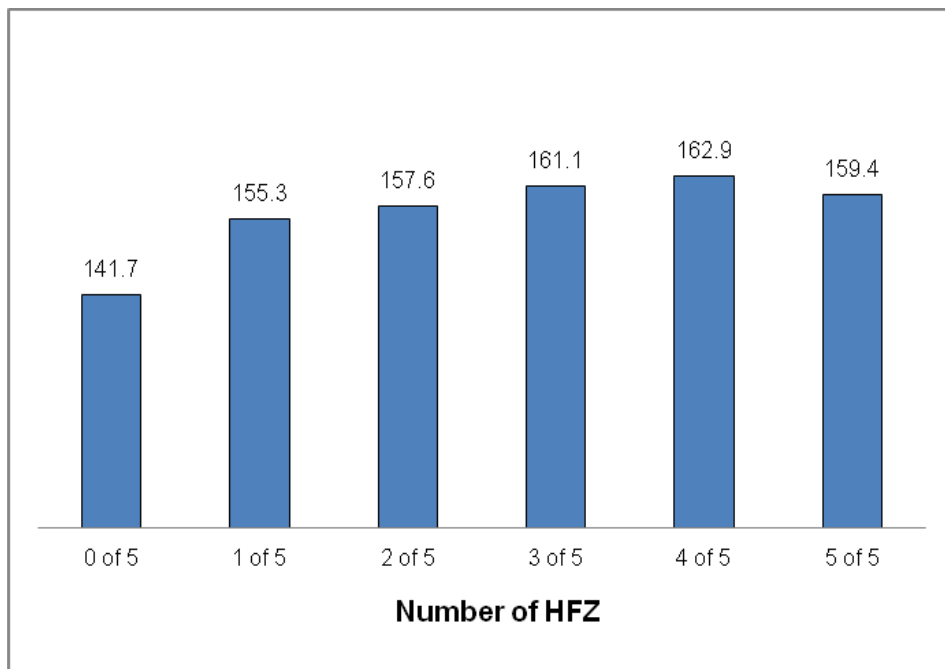


Figure 21: Mean attendance days by number of HFZ achieved for 9th & 10th grade students, SY 2009–10 (n=11,070)

LIMITATIONS

It is important to note that the analyses showing the relationships between the students' fitness level and students' school academic performance level, attendance days and days suspended were calculated by using the cross sectional data, and therefore the results do not imply causality. Thus it cannot be inferred from this report that the higher levels of physical fitness level caused an improvement or increase in academic achievement, attendance days, or suspension days. Although we statistically controlled for variables such as age, grade, gender, school district and SES, there are other variables that may influence the relationship between academic achievement, student behavior and fitness levels, for example students' study habits, social and community norms differences in parenting style and parent dynamics.

CONCLUSION

The data suggest that there is a clear and consistent relationship between academic achievement (as measured by DSTP math and reading scores) and fitness levels (as measured by performing within HFZ) among students in Delaware. This is the case for all the grade levels included in the analyses (4, 7, and 9/10) but especially so for 4th grade, where the difference between DSTP high performers and low performers in number of students achieving five of five HFZ is particularly striking.

In addition, there is a clear and consistent relationship between fitness and student behaviors such as school attendance and reduced suspension days.

Although it is not possible to infer causal links between the variables from this cross-sectional data set, these findings are important in demonstrating a compelling link between fitness, academic achievement and student behaviors among Delaware public school children. It is our recommendation that stakeholders use these findings to support Delaware schools in continued efforts to promote quality physical education and physical activity so as to enable all eligible students to achieve all five HFZs.

Appendix 1: FitnessGram® Tests

Traditional FitnessGram® assessment includes six recommended tests – PACER, Curl Up, Trunk Lift, Push-Up, Back-Saver Sit and Reach, and Skin Fold Test. These tests are designed to measure students' aerobic capacity, muscle strength, endurance and flexibility. Delaware only mandates the first five tests listed, details about which are provided below:

AEROBIC CAPACITY

- 1) **PACER** (Progressive Aerobic Cardiovascular Endurance Run) – Set to music; a paced, 20-meter shuttle run increasing in intensity as time progresses.
- OR
- One-Mile Run – Students run (or walk if need) one mile as fast as they can.
 - Walk Test – Students walk one mile as fast as they can (for ages 13 or above since the test has only been validated for this age group).

MUSCULAR STRENGTH AND ENDURANCE

- 2) **Curl Up** – Measuring abdominal strength and endurance; students lie down with knees bent and feet unanchored. Set to a specified pace; students complete as many repetitions as possible to a maximum of 75.
 - 3) **Trunk Lift** – Measuring trunk extensor strength; students lie face down and slowly raise their upper body long enough for the tester to measure the distance between the floor and the student's chin.
 - 4) **Push-Up** – Measuring upper body strength and endurance, students lower body to a 90-degree elbow angle and push up. Set to a specified pace, students complete as many repetitions as possible.
- OR
- Modified Pull-Up (proper equipment required) – With hands on a low bar, legs straight and feet touching the ground, student pull up as many repetitions as possible.
 - Flexed Arm Hang – Student hang their chin above a bar as long as possible.

FLEXIBILITY

- 5) **Back-Saver Sit and Reach** - Testing one leg at a time, student sit with one knee bent and one leg straight against a box and reach forward.
- OR
- Shoulder Stretch – With one arm over the shoulder and one arm tucked under behind the head, student try to touch their fingers and then alternate arms.



Appendix 2: Delaware Department of Education Regulation 503 Physical Education Requirements

5.0 Physical Education

5.1 Local school districts and each charter school shall provide instructional programs in physical education for each grade K to 12 with the exception of the James H. Groves High School program.

5.2 All public school students in each grade 1 to 8 shall be enrolled in a physical education program.

5.3 All public school students in grades 9 to 12 shall complete the credit in physical education necessary to graduate from high school.

5.3.1 In addition to the one credit required for high school graduation, only one additional elective credit in physical education may be used to fulfill the graduation requirements.

5.4 The physical education requirements may be waived only for students who have an excuse from a qualified physician or objections based on religious beliefs. The local school district or charter school shall have the authority to grant such waivers. The local school district or charter school shall maintain records of the waivers granted and upon request, make them available for review consistent with Federal and state confidentiality laws.

5.5 Local school districts and charter schools shall annually assess the physical fitness of each student in grades 4 and 7, and in grade 9 or 10. Beginning in the 2006–2007 school year and annually thereafter, all students in grade 4 will be assessed. Beginning in the 2007–2008 school year and annually thereafter all students in grade 7 and in grade 9 or 10 will be assessed. The physical fitness assessment tool used by the districts and charter schools shall be one designated by the Delaware Department of Education.

5.5.1 The local school districts and charter schools shall provide the results of the physical fitness assessment to the parent(s) guardian(s) or Relative Caregiver of each student. The districts and charter schools shall also report this information to the Delaware Department of Education in a format determined by the Department.

5.5.1.1 The Delaware Department of Education shall annually report the statewide grade level results of the physical fitness assessment to the public.

10 DE Reg. 985 (12/01/06)

Appendix 3: The distribution of reading performance level (PL) by HFZ for 4th, 7th and 9th & 10th grade students, SY 2009–10

4th Grade (n=10,488)						
	0 out of 5 # (%)	1 out of 5 # (%)	2 out of 5 # (%)	3 out of 5 # (%)	4 out of 5 # (%)	5 out of 5 # (%)
Reading PL						
Well below the standard	29 (22.1)	75 (12.7)	195 (11.0)	254 (7.4)	209 (4.8)	5 (2.3)
Below the standard	27 (20.6)	120 (20.3)	338 (19.1)	536 (15.7)	543 (12.4)	13 (6.0)
Meets the standard	55 (42.0)	270 (45.8)	761 (43.1)	1,639 (48.0)	1,977 (45.3)	73 (33.6)
Exceeds the standard	13 (9.9)	88 (14.9)	273 (15.4)	569 (16.7)	840 (19.2)	35 (16.1)
Distinguished	7 (5.3)	37 (6.3)	200 (11.3)	416 (12.2)	800 (18.3)	91 (41.9)
Total	131 (100.0)	590 (100.0)	1,767 (100.0)	3,414 (100.0)	4,369 (100.0)	217 (100.0)
7th Grade (n=7,471)						
	0 out of 5 # (%)	1 out of 5 # (%)	2 out of 5 # (%)	3 out of 5 # (%)	4 out of 5 # (%)	5 out of 5 # (%)
Well below the standard	45 (16.1)	66 (8.7)	80 (5.4)	76 (3.6)	55 (2.4)	14 (2.9)
Below the standard	48 (17.1)	103 (13.6)	162 (10.9)	199 (9.4)	168 (7.2)	32 (6.5)
Meets the standard	156 (55.7)	469 (62.0)	949 (63.6)	1,352 (63.6)	1,405 (60.4)	282 (57.6)
Exceeds the standard	28 (10.0)	101 (13.3)	264 (17.7)	422 (19.8)	563 (24.2)	136 (27.8)
Distinguished	3 (1.1)	18 (2.4)	37 (2.5)	77 (3.6)	135 (5.8)	26 (5.3)
Total	280 (100.0)	757 (100.0)	1,492 (100.0)	2,126 (100.0)	2,326 (100.0)	490 (100.0)
9th & 10th Grade (n=10,582)						
	0 out of 5 # (%)	1 out of 5 # (%)	2 out of 5 # (%)	3 out of 5 # (%)	4 out of 5 # (%)	5 out of 5 # (%)
Well below the standard	56 (22.7)	106 (17.2)	188 (11.9)	258 (8.5)	267 (6.7)	60 (5.3)
Below the standard	49 (19.8)	140 (22.7)	370 (23.3)	603 (19.9)	649 (16.3)	191 (16.9)
Meets the standard	124 (50.2)	329 (53.2)	873 (55.1)	1,779 (58.8)	2,355 (59.2)	644 (57.0)
Exceeds the standard	14 (5.7)	35 (5.7)	114 (7.2)	261 (8.6)	494 (12.4)	149 (13.2)
Distinguished	4 (1.6)	8 (1.3)	40 (2.5)	122 (4.0)	214 (5.4)	86 (7.6)
Total	247 (100.0)	618 (100.0)	1,585 (100.0)	3,023 (100.0)	3,979 (100.0)	1,130 (100.0)

Appendix 4: The distribution of math performance level by HFZ for 4th, 7th and 9th & 10th grade students, SY 2009–10

4th Grade (n=10,811)						
	0 out of 5 # (%)	1 out of 5 # (%)	2 out of 5 # (%)	3 out of 5 # (%)	4 out of 5 # (%)	5 out of 5 # (%)
Math PL						
Well below the standard	41 (27.5)	152 (23.8)	249 (13.5)	302 (8.6)	206 (4.6)	9 (4.1)
Below the standard	36 (24.2)	102 (16.0)	300 (16.3)	451 (12.8)	412 (9.3)	12 (5.5)
Meets the standard	46 (30.9)	242 (37.9)	722 (39.2)	1,499 (42.7)	1,722 (38.7)	39 (17.8)
Exceeds the standard	16 (10.7)	89 (13.9)	369 (20.0)	797 (22.7)	1,151 (25.8)	60 (27.4)
Distinguished	10 (6.7)	53 (8.3)	201 (10.9)	461 (13.1)	963 (21.6)	99 (45.2)
Total	149 (100.0)	638 (100.0)	1,841 (100.0)	3,510 (100.0)	4,454 (100.0)	219 (100.0)
7th Grade (n=7,525)						
	0 out of 5 # (%)	1 out of 5 # (%)	2 out of 5 # (%)	3 out of 5 # (%)	4 out of 5 # (%)	5 out of 5 # (%)
Well below the standard	112 (39.6)	202 (26.5)	286 (19.0)	312 (14.6)	236 (10.1)	47 (9.5)
Below the standard	37 (13.1)	108 (14.2)	206 (13.7)	235 (11.0)	188 (8.0)	53 (10.8)
Meets the standard	102 (36.0)	339 (44.5)	696 (46.2)	1,001 (46.7)	1,008 (43.2)	210 (42.6)
Exceeds the standard	15 (5.3)	59 (7.7)	156 (10.3)	265 (12.4)	382 (16.4)	82 (16.6)
Distinguished	17 (6.0)	54 (7.1)	164 (10.9)	330 (15.4)	522 (22.3)	101 (20.5)
Total	283 (100.0)	762 (100.0)	1,508 (100.0)	2,143 (100.0)	2,336 (100.0)	493 (100.0)
9th & 10th Grade (n=10,688)						
	0 out of 5 # (%)	1 out of 5 # (%)	2 out of 5 # (%)	3 out of 5 # (%)	4 out of 5 # (%)	5 out of 5 # (%)
Well below the standard	97 (38.6)	196 (31.4)	453 (27.0)	546 (17.9)	526 (13.1)	139 (12.2)
Below the standard	61 (24.3)	149 (23.9)	357 (22.3)	677 (22.2)	800 (19.9)	194 (17.1)
Meets the standard	63 (25.1)	198 (31.7)	548 (34.2)	1,167 (38.2)	1,590 (39.5)	449 (39.5)
Exceeds the standard	14 (5.6)	35 (5.6)	137 (8.6)	340 (11.1)	518 (12.9)	140 (12.3)
Distinguished	16 (6.4)	46 (7.4)	126 (7.9)	323 (10.6)	588 (14.6)	215 (18.9)
Total	251 (100.0)	624 (100.0)	1,601 (100.0)	3,053 (100.0)	4,022 (100.0)	1,137 (100.0)

REFERENCES

- ⁱ Gordon-Larsen P, McMurray RG, Popkin BM. 2000. Determinants of adolescent physical activity and inactivity patterns. *Pediatrics*. 2000;105(6):1-8.
- ⁱⁱ Sallis, JF, Prochaska, JJ, Taylor, WC. A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise*. 2000;32(5):963-975.
- ⁱⁱⁱ Sallis, JF, Conway, TL, Prochaska, JJ, McKenzie, TL, Marshall, SP, Brown, M. The association of school environments with youth physical activity. *American Journal of Public Health*. 2001;91(4): 618-620.
- ^{iv} Nemours Health & Prevention Services, Center for Evaluation & Research; 2008 Delaware Children's Health Survey Descriptive.
- ^v Nemours Health & Prevention Services, Center for Evaluation & Research; Middle School and High school Youth Risk Behavioral Surveillance Survey (YRBSS) [2007 and 2009 combined]
- ^{vi} Paffenbarger, RS, Hyde, RT, Wing, AL, Hsieh, C. Physical activity, all-cause mortality, and longevity of college alumni. *New England Journal of Medicine*. 1986;314(10):605- 613.
- ^{vii} Taras, H. Physical Activity and Student Performance at School. *Journal of School Health*. 2005;75(6): 214-218.
- ^{viii} Satcher, D. Healthy and Ready to Learn: Research shows that nutrition and physical activity affect student academic achievement. *Educational Leadership*. 2005;63:26-30.
- ^{ix} Tremblay, MS, Williams, JD. (1999) The need to increase physical activity during the elementary and middle school years. Policy Brief Atlantic Centre for Policy Research. University of New Brunswick NO. 7, downloaded March 31, 2011 <http://www.unb.ca/crisp/pdf/pbrief7.pdf>
- ^x Tremblay, M, Pella, T, Taylor, K. The quality and quantity of school based physical education: A growing concern. *CAPHERD Journal*. 1996;62: 4-7.
- ^{xi} Tremblay, MS, Inman, JW, Williams, JD. The relationship between physical activity, self-esteem, and academic achievement in 12-year-old children. *Pediatric Exercise Science*. 2000;12: 312-324.
- ^{xii} Scheuer, L, Mitchell, D. (2003). Does physical activity influence academic performance? The New PE and Sports Dimension. Retrieved March 31, 2011 from <http://www.sports-media.org/sportapolisnewsletter19.htm>
- ^{xiii} The Cooper Institute. *FitnessGram Overview*. Retrieved March 31, 2011 from <http://www.fitnessgram.net/programoverview/>
- ^{xiv} Chomitz VR, Slining MM, Mitchell SE, Dawson GF, Hacker KA. Is there a relationship between physical fitness and academic achievement? Positive results from public school children in the northeastern United States. *Journal of School Health*. 2009;79(1):30-37.