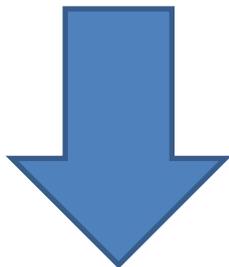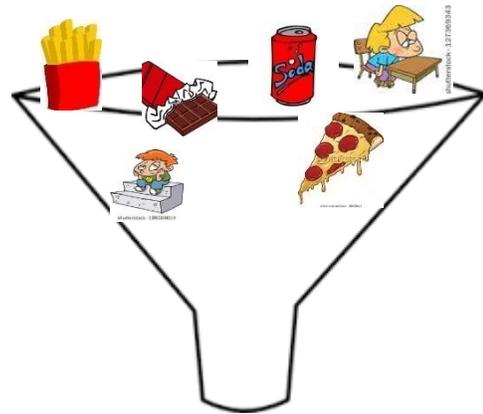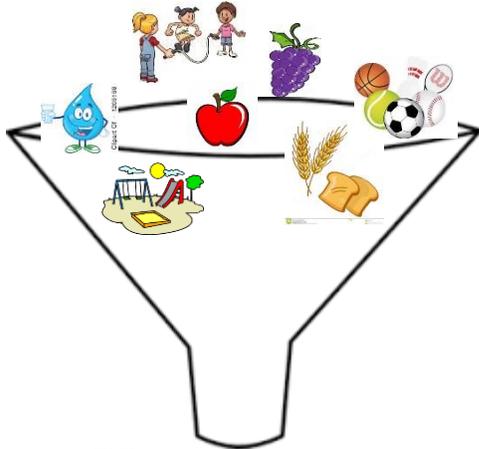# Veritas Community School Project Report

2015-2016 Academic School Year

Prepared By Keri Elliott Revens, MS, CHES

On behalf of the Veritas Research Group

- Increased Cognitive Function
- Decreased Concentration
- Enhanced Mental Well-being
- Increased Physical Activity
- Decreased Risk of Obesity
- Decreased Risk of Chronic Diseases
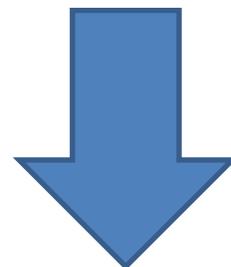
- Decreased Cognitive Function
- Interrupted Concentration
- Decreased Mental Well-being
- Decreased Physical Activity
- Increased Risk of Obesity
- Increased Risk of Chronic Diseases

Introduction

The Physical Activity Guidelines for Americans recommend that children aged 6-17 get 60 minutes or more of physical activity (PA) each day, the majority of which should be moderate to vigorous physical activity (MVPA) (U.S. Dept. of Health and Human Services 2008). In a nationally representative sample of children aged 6-15, only about one fourth of children obtained sufficient levels of activity (Troiano, Berrigan, Dodd, Masse, Tiler, McDowell, 2008). The many benefits of physical activity (PA) are widely known; these include improved strength and endurance, reduced stress and anxiety, increased self-esteem, weight management, and healthier bones and muscles (CDC 2010).

Physical inactivity is a known predictor of obesity; childhood obesity levels have tripled over the past 30 years; more specifically, the percentage of obese children aged 6-11 increased from 7% to 18% since 2012 (Ogden et al., 2014). According to Healthy People 2020, obesity among children and adolescents aged 2-19 has been identified as one of the Nation's top indicators of health (US Dept. of Health and Human Services 2014). Obesity is associated with a number of health risks in the short and long term; short term effects in youth include sleep apnea, bone and joint problems, as well as social and psychological problems, such as low self-esteem and stigma (Daniels et al. 2005; Office of the Surgeon General 2010; Dietz et al. 2004).

In the long term, obese children and adolescents are at a greater risk for developing high cholesterol, high blood pressure, and excess adiposity, all factors that put them at risk for cardiovascular disease, as well as type pre-diabetes (Freedman et al. 1999; Freedman et al. 2005; Freeman et al. 2007; Li et al., 2009). Other studies have found that obese youth are more likely to be obese as adults compared to those who are not obese whereas active children are more

likely to be active as adults (Freedman et al. 2005; Telama, Yang, Laakso, Vikari, 1997; Telama, Yang, Viikari, Valmaki, Wanne, Raitakari, 2005). Instilling the value of PA and providing multiple opportunities for PA to children at a young age is vital to their health and well-being.

Schools are an ideal setting for PA interventions as students spend the majority of their waking hours in school and schools can provide trained personnel, necessary equipment, and a safe environment for PA (Mahar et al., 2011, Kriemer et al., 2011, St. Leger and Nutbeam, 2000). Schools may also benefit from PA programs as evidence shows PA has also been associated with enhanced academic performance, including improved test scores, concentration, and time on task (Sibley and Etneier, 2003; CDC 2010; Pucher et al., 2013; Sallis et al., 1999; Coe et al., 2006).

Background

Veritas Community School serves children in grades K-3. Veritas delivers an educational experience with a focus on health and wellness. The curriculum is focused on three pillars: the core knowledge sequence, health and wellness, and peaceful classroom. The Health and Wellness pillar includes frequent opportunities for movement, challenging daily exercise, and freshly prepared meals to fuel academic achievement and a calm learning environment. The College of Health and Human Services at the University of North Carolina at Charlotte partnered with Veritas Community School to examine the effects of a school-based PA program on a number of academic and health outcomes of students after one year of enrollment.

Research Questions

The Veritas Community School PA program includes 20 minutes of morning movement, 60 minutes of physical education (PE), 30 minutes of daily recess, and at least one 10 minute

classroom PA break each day.   This research aimed to address the following questions regarding

Veritas's school-based PA program:

1. Is there an association between fitness levels and academic achievement in students

   enrolled at Veritas Community School?

2. Do students at Veritas meet the guidelines of PA, including those for MVPA?

   ➢ Do PA and MVPA levels differ by gender, grade level, or ethnicity?

3. Does participation in the PA program at Veritas improve children's fitness levels?

Research Question 1. Evidence shows time spent in school-based PA, including

classroom PA and PE, does not hinder academic performance, even when implemented in place

of regular classroom instruction (Pucher et al., 2013). Moreover, a substantial amount of

evidence shows that PA has the ability to enhance academic performance; a number of studies

have found improvements in grades, standardized test scores, and classroom behavior as a result

of PA interventions (CDC 2010; Van der mars, 2006; Sallis et al., 1999, Coe et al., 2006;

Donnelly et al., 2009; Ahamed et al., 2007; Skip et al., 2013).

While there is a large body of evidence surrounding PA and academic achievement, less

research has been done on the association between academic achievement and fitness. Of the

existing evidence, findings are mixed. A study of more than 2.4 million students in Texas found

a positive association between students who were physically fit and standardized test scores in

grades 3-12 (Texas Education Agency, 2009). Conversely, another study found no differences

between low and high fitness groups on math and English test scores in third grade students but

found a significant difference between math and social studies test scores between the low and

high fitness group in 6th and 9th grade students (Coe, Peterson, Blair, Schutten, Peddie, 2013). Another study found that muscular strength, including handgrip strength and standing long jump distance, was not significantly associated with academic performance whereas cardiorespiratory capacity and motor ability were (Esteban-Cornejo, Tejero-Gonzalez, Gomez, del-Campo, Gonzalez, Padilla-Modelo et al., 2014). Inconsistent findings and the lack of a systematic form of fitness measurement merit the need for further research on the association between academic achievement and fitness levels.

Research Question 2. In addition to its effects on academic performance, evidence shows that school-based PA interventions can increase overall activity levels (Carlson et al., 2015, Bershwinger and Brusseau, 2013; Sirota et al., 2014; Norris et al., 2015). One PA intervention found that students in classrooms with activity breaks were more likely to obtain 30 minutes of MVPA per day compared to students with no activity breaks (Carlson et al., 2015). Another found that students in grades 3-5 increased their step county by 672 steps per day and increased daily MVPA by two minutes after participating in a PA intervention (Goh et al., 2014). Similarly, another study found that children in grades 3-5 at schools participating in a PA intervention had 13% more PA and 27% greater levels of MVPA compared to children at schools with no PA intervention (Donnelly et al., 2011).

While there is some evidence that school-based PA increases MVPA levels, little research has been conducted on children in grades K-2 (Norris, et al., 2015). More data on PA levels of young children is needed to better understand PA prevalence by age. Further, the majority of existing studies have captured overall PA levels, failing to measure intensity levels of PA. To reap the health benefits of PA, the majority of children's PA minutes should be MVPA

thus it is important to gain a better understanding of how school-based PA impacts MVPA levels.

Research Question 3. Compared to PA levels, less research has been done on the impact of school-based PA programs on fitness levels. Of studies that have been done, fitness levels have been measured in a variety of ways, including muscle strength, aerobic capacity, and motor ability. One study found that students at schools with classroom activity breaks showed greater improvements in the areas of abdominal strength, upper-body strength, and trunk extension compared to students at control schools (Katz et al. 2010). Another study found that students at interventions schools with 5 PE classes per week and daily classroom PA breaks showed an increase in aerobic fitness measured by the shuttle run compared to students at schools with only 3 PE classes and no PA breaks (Zahner, Puder, Roth, Schmid, Guldimann, Puhse, et al., 2006). Conversely, a systematic review found that only 6 out of 11 studies on school-based PA found improvements in fitness levels (Kriemler, Meyer, Martin, van Sluijs, Andersen, Martin, 2011). Inconsistencies in findings and measurement techniques warrant the need for further research to examine the effects of school-based PA programs on fitness levels.

Methods

This was a secondary data analysis of data collected at Veritas Community School. PA and fitness data were collected as part of the school's PE program by the PE teacher. MAP scores were collected by the school as part of the normal testing procedures. Demographic data, including age, gender, and ethnicity was also collected by the school. All students were assigned a research ID number before data was given to the research team. Data was stored on

the first researcher's University H drive which can only be accessed with the researcher's username and password.

Participants. For fitness and academic data collection, participants included a total of 110 children in grades kindergarten through third: 40 kindergarteners, 25 first grade students, 23 second grade students, and 22 third grade students. There were a total of 67 females and 42 males. There were 46 white students and 62 nonwhite students. PA data was only provided for second and third grade children. There were a total of 34 second and third grade children: 15 males and 19 females. Of these 34 children, 20 were white and 14 were non-white.

Fitness Measures. Fitnessgram, a nation-wide youth related assessment that utilizes evidence-based standards to measure the level of fitness needed for good overall health, was used to measure fitness levels (California department of Education, 2015). Fitnessgram assessments include tests on curl-ups, push-ups, and the pacer; for each test, students are expected to do the maximal amount. Curl up and push-up assessments are tests of muscular strength while the pacer assessment is a test of endurance. The performance goal for all 3 tests of the Fitnessgram is the Healthy Fitness Zone (HFZ). The HFZ represents the level of fitness required for protection against the diseases that result from sedentary living.

All students performed assessments in September of 2015, January of 2016, and May of 2016. However, only scores from September (pre) and May (post) were used for analysis. All Fitnessgram assessments were performed by the PE teacher. In conjunction with Fitnessgram assessments, the PE teacher also collected measurements on height and weight for each student. The first author used height and weight measurements to determine BMI, BMI percentile, and weight classification from standards set by the CDC (CDC, 2015).

MAP scores were collected as part of the standard testing procedures for the school. MAP testing also occurs three times throughout the academic year but in conjunction with fitness scores, only September (pre) and May (post) scores were used in analysis. MAP testing includes assessments in math and reading. However, for reasons not reported to the research team, students did not take the math portion of the MAP test in September thus only reading scores were available for analysis.

PA data was collected in June of 2016. PA data was collected using the FITstep™ Pro Uploadable pedometer; the pedometer measures distance, caloric expenditure, step count, total activity time, and time spent in MVPA. Activity levels were measured in minutes. Pedometers were only worn by second and third grade students. Each participant wore the pedometer for up to 8 week days. Pedometers were worn during school and non-school time.

Data analysis. STATA was used for statistical analysis. All data collected in September is referred to as time point 1 and data collected in May is referred to as time point 2. Frequency statistics were conducted to determine students in each grade level, gender, and ethnicity. Descriptive statistics were conducted to determine mean and standard deviation of total PA levels, MVPA levels, fitness scores, MAP scores, and BMI levels.

Fitness levels and academic achievement. The outcome variable was reading growth and the predictor variables were curl up growth, push up growth, and pacer growth. Reading scores from time point 1 were subtracted from time point 2 to create the outcome variable: reading growth. The same was done for each set of fitness scores to create 3 predictor variables: curl up growth, push up growth, pacer growth. Correlation analysis was conducted on reading growth and curl up growth, push-up growth, and pacer growth to determine if reading growth

was correlated with fitness growth. Multiple regression analysis was performed to determine whether curl up growth, push-up growth, or pacer growth was a significant predictor of reading growth.

Fitness levels. Two-sample t-tests were used to determine whether there was a significant difference between the mean of curl up scores at time 1 and 2; the same test was run for push-up and pacer scores.

Total PA and MVPA minutes. The outcome variables were total activity minutes and MVPA minutes and the predictor variables were gender, grade level, ethnicity, and BMI. The Fitstep Pro pedometer records activity in hours, minutes, and seconds. All data was converted to minutes; seconds were round up to the nearest minute. Descriptive statistics were conducted to determine mean and standard deviation of activity and MVPA levels. PA levels were categorized into 3 categories: 60-90 minutes, 90-120 minutes, and over 120 minutes; descriptive statistics were conducted to determine how many students fell into each category. ANOVA was conducted to test for differences in mean PA levels and in mean MVPA minutes based on gender, ethnicity, and grade level.

Multiple regression analysis was performed to determine whether BMI was a significant predictor of total activity minutes and MVPA minutes. Dummy variable coding was used for BMI categories; dummy variable multiple regression analysis was performed with total activity minutes as the dependent variable to determine whether BMI category was a significant predictor of activity. The same was done for MVPA minutes. Analyses of BMI were run again to control for gender, ethnicity, and grade level.

Results

The means for all variables can be seen in Table 1. The results for each research question are presented below.

Table 1

	All	Male	Female	White	Non-white
Physical Activity					
Total PA minutes	116	120	112	113	120
MVPA minutes	100	103	99	99	102
Fitness					
Curl up growth	9	15	6	6	11
Push-up growth	10	9	10	9	10
Pacer growth	20	21	19	21	18
Academics					
Reading growth	18	17	18	16	19

Association between fitness levels and academic achievement. There were not strong correlations between reading growth and any of the three fitness tests: curl up, push-up, or pacer. There was a very week negative correlation between curl up growth and reading growth (-0.14) and between pacer growth and reading growth (-0.11). Although the correlation between push-up growth and reading growth (0.26) was the highest, it is still very weak. *None of the three fitness scores were found to be a significant predictor of reading growth.*

Program effects on PA levels. All students received, on average, a minimum of 60 minutes of total PA each day. The minimum number of total activity minutes was 69, the maximum was 186, and the mean was 116. Ninety seven percent of students received on average at least 60 minutes or more of MVPA per day. The minimum number of MVPA minutes was 31, the maximum was 161, and the mean was 124. The percentage of students who

achieved PA minutes by category can be seen in Figure 1. The break down by gender and

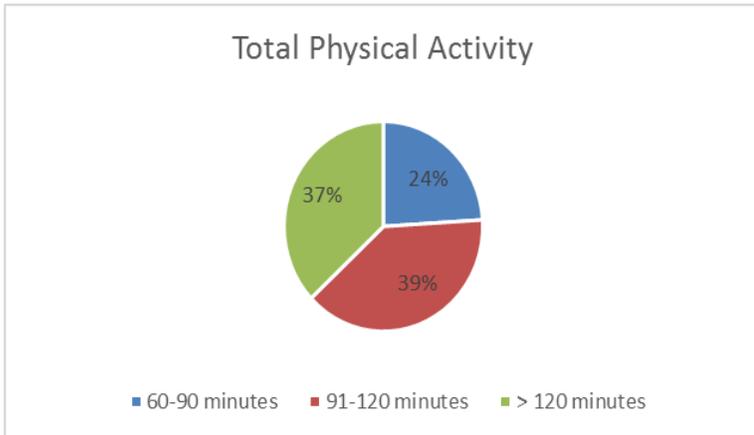ethnicity can be seen in Table 2.

Figure 1

Table 2

Total Physical Activity

| Physical Activity	Male	Female	White	Non-white
60-90 minutes	16%	33%	30%	14%
90-120 minutes	42%	33%	40%	36%
>120 minutes	42%	33%	30%	50%

There were no significant differences between mean total PA or MVPA minutes by

gender or ethnicity. Males were slightly more active than females but the difference was not

significant. Likewise, non-whites were slightly more activity than whites but the difference was

not significant. Third grade students were significantly more active (p=0.031) and had

significantly more MVPA (p=0.032) than second grade students; the association remained

significant after controlling for BMI and gender. ***BMI was positively associated with total***

activity (p=0.005) and MVPA (0.008) even when controlling for gender, grade, and ethnicity.

Program effects on Fitness levels. There was a significant difference in the mean of all

fitness scores: curl up scores (p=0.0002), push up scores (p=0.0000), and pacer scores

(p=0.0000) at time point 1 and time point 2. All scores were significantly higher at time point 2

as compared to time point 1. Males had significantly higher growth in curl up scores (p=0.0113)

as compared to females; there was no significant difference between push-up or pacer scores

between genders. There were no significant differences in any of the fitness scores between

white and non-white students. Fitness score growth for each Fitnessgram test can be seen in

Figure 1. Additional graphical displays of fitness improvements can be seen in Appendix A.

There was also a significant difference in mean BMI at time point 1 and time point 2; mean BMI

was higher at time point 2 as compared to time point 1.

Figure 2
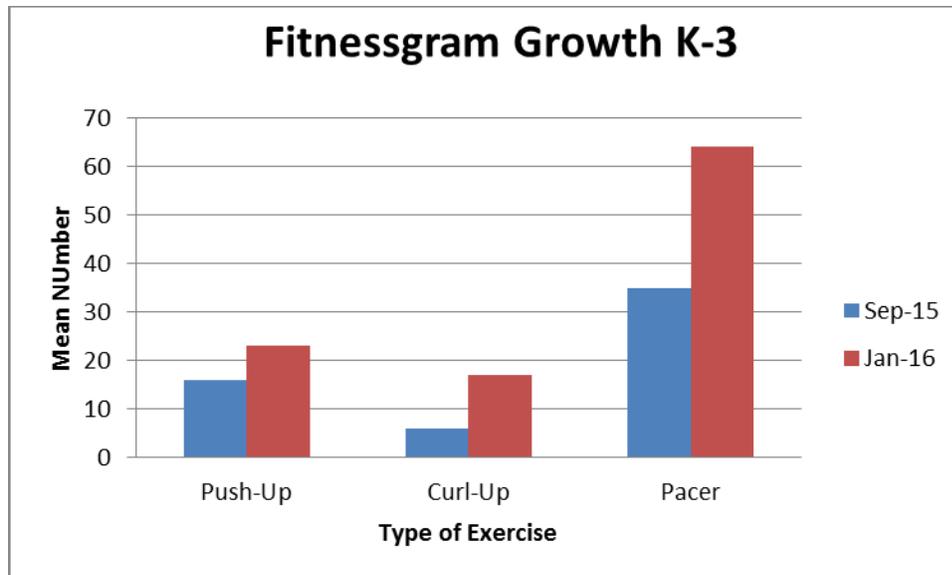
Discussion

Students showed significant improvements in all three exercises in the Fitnessgram

assessment, curl-ups, push-ups, and pacer, after one year of participation in the PA program at

Veritas School. These results suggest that participation in a PA program with multiple

opportunities for PA at school, including daily PE, may help children improve fitness levels.

Though the current study did not account for PA outside of school that may also contribute to

improved fitness levels, these results lend support to the implementation of school health policies

that increase the amount of opportunities children have to be active at school.

The dose and frequency of PE classes is a key component that should be considered by schools when designing a PA program as it is likely that the observed increase in fitness levels in Veritas students was due, at least in part, to the frequency of PE classes. PE is distinguished from other PA opportunities, such as morning movement, classroom breaks, and recess (where the primary goal is to get children moving) because it is focused on the instruction of specific exercises and body movements, is guided by a skilled instructor, and is offered for a longer period of time. This hypothesis regarding the frequency of PE classes should be tested in the future through the use of a comparison school where students receive less PE.

Children who are given multiple opportunities for PA at school also met PA recommendations of 60 minutes or more daily and all but one child received, on average, more than 60 minutes of MVPA daily. These findings are significant given that 75% of US children do not receive 60 minutes or more of PA (Trioano et al., 2008). PA levels were significantly higher in third grade students compared to second grade, but there were no differences in total PA or MVPA by gender or ethnicity. Future research should include other grade levels for greater generalizability. The use of a comparison school would also help demonstrate the importance of offering multiple opportunities for PA, not just through PE but through the use of morning movement, recess, and classroom PA breaks.

There were no significant associations between growth in reading scores and fitness growth in any of the three exercises. There are a number of possible explanations for why no association was found. First, the MAP test adjusts the level of each question to match the child's ability level based on the previous question, meaning children are not taking the exact same test each time; this can cause a great deal of variability in test scores that are not accounted for in this research. Additionally, a number of factors affect a child's test score that could not be controlled

for, including test anxiety and testing conditions. Other measures using the same test at each time point may better depict the true association between academic achievement and fitness levels. Moreover, although there was no association between reading scores and fitness levels, reading scores significantly improved from time point 1 to time point 2, suggesting that PA at school did not hinder academic performance.

Average BMI was found to be higher at time point 2 compared to time point 1. A possible explanation for this may be that children were gaining muscle mass thus increasing BMI; children significantly improved scores on activities that require muscular strength- push up and curl up. BMI is simply a measure of height and weight and does not consider muscle mass. In addition, many children grew several inches throughout the course of the school year which would also affect BMI levels. BMI levels were also positively associated with total activity minutes.   One possible explanation for this may be that students with more PA were also more physically fit and thus have more muscle mass and higher BMI. However, this is just speculation and should be formally tested in the future.

Limitations

There are a number of limitations in the present study. First, socioeconomic status (SES) was not measured and thus was not controlled for; SES is a known predictor of PA and fitness levels (Drenowatz, Eisenmann, Pfeiffer, Welk, Heelan, Gentile, et al., 2010). Further, evidence shows SES is more than three times more important than race in predicting academic outcomes (Battle & Lewis, 2008). Future research should collect data on SES, as well as race and ethnicity, and adjust statistical models accordingly.

Second, fitness data was collected by the PE teacher of the school who was not blinded to student identity or the goals of the project, resulting in potential bias and an overestimation of fitness improvements. Third, BMI is an inconsistent measure of body composition to use with children as they are still growing and developing; future studies should use measures of body fat, such as skin fold tests, to investigate the associations between academic achievement, PA levels, fitness levels, and BMI. Fourth, the use of the MAP test to measure academic growth may result in variability in test scores; the use of a standardized test would account for this problem in the future. Finally, this study used a very small sample size, making it more difficult to reach statistically significant levels and to generalize to other populations.

Conclusion

Results from this study show that children who were offered multiple opportunities for PA at school significantly improved fitness levels in the areas of curl ups, push-ups, and the pacer test and met the recommendations for PA guidelines, including those for MVPA. Although no significant association was found between fitness growth and academic growth, participation in PA at school did not hinder students' academic performance as students significantly improved reading scores from time point 1 to time point 2. These results add to the existing body of researching surrounding PA and academic outcomes and lend support to the implementation of school health policies that provide more opportunities for children to be active at school.

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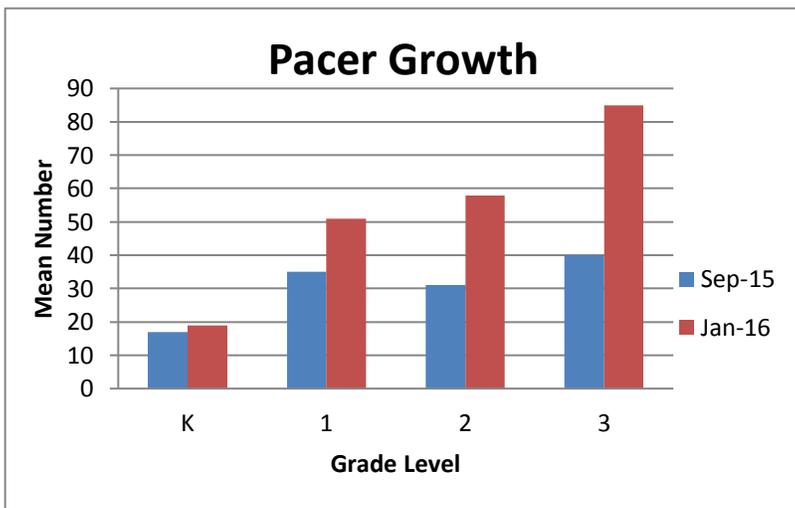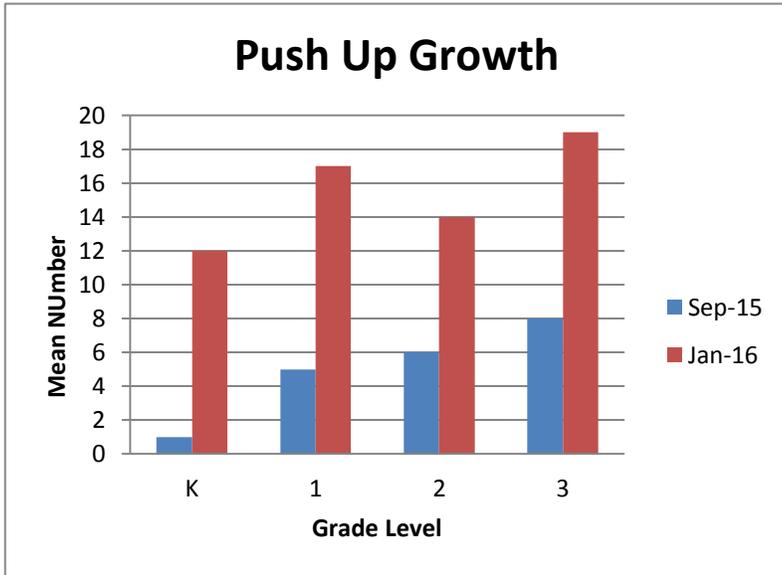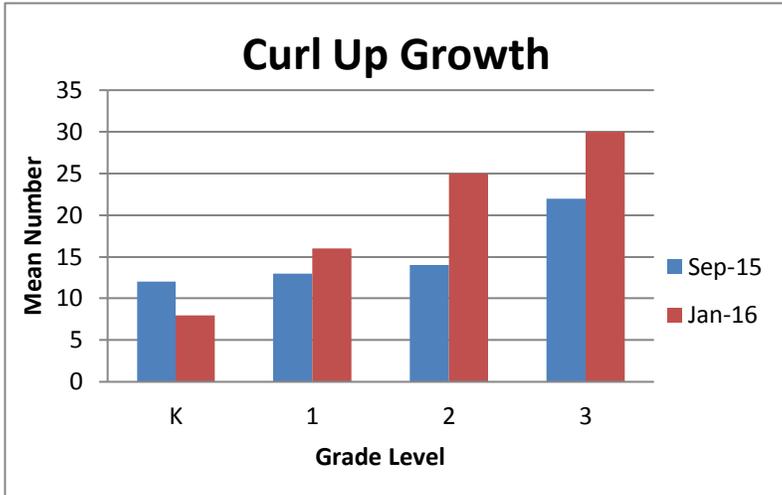
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Appendix A

Curl Up Growth

Push Up Growth

Pacer Growth

Fitness Growth

% of students in HFZ

Type of Exercise	Sep-15	May-16
Curl Ups	70	98
Push Ups	35	83
Pacer	70	93