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Physical Activity Events for Children: Do the Benefits Justify Time Away from Academics?

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Physical Activity Events for Children: Do the Benefits Justify Time Away from Academics?
A Synthesis of the Research Literature

A Synthesis Project
Presented to the
Department of Kinesiology, Sports Studies and Physical Education
The College at Brockport
State University at New York

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science in Education
(Athletic Administration)

By
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Title of Synthesis: Physical Activity Events for Children: Do the Benefits Justify Time Away from Academics?

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Abstract

The purpose of this synthesis project was to research the effect that physical activity events have on children’s academic achievement. A comprehensive literary search was completed to find studies that implemented recess, classroom based physical activity, physical education, extracurricular physical activity or sports into the lives of K-12 students. Fourteen academic research reports, journal articles and scholarly peer reviewed articles between the years of 2000-2016 were chosen for the review of literature.

The differences that exist between the forms of physical activity and their impact on academic performance were examined. A strong research base for physical activity improving children’s physical health, cognition as well as behavior was found. Physical activity was also demonstrated to have a positive influence on elementary and secondary students’ academics. Therefore, the benefits outweigh the negatives when it comes to the relationship between children performing physical activity and their academics.

Keywords: Fitness, well-being, academic performance, school-aged students, teenagers, academic success, sports, recreation, physical education
Chapter 1: Introduction

According to research completed by the Department of Health and Human Services, Centers for Disease Control and Prevention (2010) physical activity can affect the brain’s physiology. This is seen by physical evidence such as increased oxygenation and neurotransmitter levels, development of increased nerve connections, blood flow, cerebral capillary growth, brain tissue volume and growth of nerve cells in the hippocampus (which is the center for memory and learning). From these physiological changes, benefits may include enhanced coping ability, reduced cravings, decreased pain as well as improved attention, improved information processing, storage and retrieval (HHS-CDC, 2010).

For children, findings of new studies show that children who are physically fit may have a larger amount of gray matter within their brains which may lead to improved academic performance. Researchers claim that a study with eight to eleven-year-olds proved that exercise did in fact boost grey matter in nine different areas of the brain (Shiva, 2017). Studies have proposed that physical activity may have an influence on academic performance through an array of indirect and direct cognitive, physiological, emotional, and learning mechanisms. Research completed on brain development demonstrates that cognitive development occurs simultaneously with motor ability (Messiah, 2017). Long-term studies have revealed increases in physical activity as a result of more time spent in physical education, leading to an associated improvement in academic performance. Lone sessions of physical activity have even been connected with improved concentration, grades on academic tests and more orderly shifts of information from short- to long-term memory (Active Living Research, Jan. 2015).

Four main types of activity that most United States school children engage in include physical education, recess, classroom based physical activity as well as extracurricular physical
activity. Within the United States, the recommended requirement for physical education in elementary schools is at least 150 minutes per week and at least 225 minutes per week in middle schools and high schools (SHAPE, 2016). The Center for Disease Control and Prevention recommends a combination of 60 minutes of physical activity for school-aged children between before, during or after school. This to help combat lengthy periods of inactivity (SHAPE, 2016). Elementary children should be encouraged to engage in age-appropriate activities which offer free play such as chasing games, running, tag, jumping rope and youth sports. The activities should be related to and in line with the child’s stage of fundamental motor skills development (Messiah, 2017). The development of complex motor skills in teenagers and adolescents allows them to take part in active recreation activities such as rollerblading, kayaking and train/mountain biking. This also opens them up to do resistance exercises with weight machines or free weights and participate in individualized sports like bicycling and team sports like basketball, baseball or football, for example (Messiah, 2017).

Yet, today, several states across America are not required to have recess time throughout the school day for children. Florida students are now guaranteed to have twenty minutes of recess per day at school which is something that the state lacked before a new state law enacted in the summer of 2017 (Reilly, 2017). Currently, only 17.1% of high school students within the United States satisfy the current recommendations for physical activity (Messiah, 2017). The United States Department of Health and Human Services claims that children and adolescents should take part in at least 60 minutes of physical activity per day (HHS, 2008). A large portion of the daily recommended sixty minutes of activity should be of moderate- to vigorous-intensity aerobic physical activity. On at least three days per week, physical activity should also include vigorous-intensity (HHS, 2008). As a part of the recommended 60+ minutes of physical activity
per day, children as well as adolescents should participate in muscle-strengthening activities, at least three of the days (HHS, 2008). As a portion of the 60+ recommended minutes of physical activity daily, bone-strengthening activities should be done on at least three days during the week (HHS, 2008).

Tomporowski, Lamboune and Okumura (2011) state that the results of their review of literature indicate that exercise promotes the emergence of a child’s mental function, especially their executive functioning (Tomporowski, et. al., 2011). Physical activity has been shown to have positive influences on classroom behavior, memory, and concentration of school-aged children. Data drawn from quasi-experimental studies have found support in mechanistic experiments on cognitive function. These results pointed to a positive correlation existing between intellectual performance and physical activity (Trudeau & Shepard, 2008). Through their review of literature, Trudeau and Shepard concluded that setting aside an additional hour per day of curricular time for physical activity programs was not found to have a negative effect on the academic performance of primary school children. Despite the fact that the time spent on other subjects would typically show an associated reduction (Trudeau & Shepard, 2008).

**Statement of the Problem**

The United States is in an obesity epidemic that is currently on the rise and one in every five-school aged child is obese, according to the United States Department of Health and Human Services, Center for Disease Control (2010). This is more than triple the number of school-aged children who were identified as obese in the 1970’s. The Department of Health and Human Services has discovered that lack of physical activity in children leads to an increase in the risk factors which, in turn, lead to many hypokinetic diseases. These diseases include cardiovascular...
disease, many forms of cancer, type 2 diabetes, energy imbalance and low bone density. A very eye-opening finding from the Society of Health and Physical Educators (SHAPE) includes that “42% of children (ages 6-11) and 8% of adolescents (ages 12-19) engaged in the recommended 60 minutes of physical activity most days of the week in a 2008 study” (SHAPE 2010, p. 10). “Twenty-five percent of children and adolescents (ages 12-15) met recommended levels of daily physical activity in 2012” (SHAPE 2010, p. 10). This demonstrates why it is vital for children to take part in physical activity.

As stated by the Shape of the Nation Report, 2016, in 86.3% or 44 out of 51 states, elementary schools are required to have physical education opportunities (SHAPE, 2016). Just a bit more than three-quarters of states (39 out of 51 states, 76.5%) require elementary school children to take a physical education class in at least one grade between kindergarten and fifth grade (SHAPE, 2016). Out of the states that do require elementary schools to have physical education, a total of 34 out of 29 states or 87.2% require kindergarten students to take a physical education class (SHAPE, 2016). In 80.4% or 41 out of 51 states, middle and junior high schools are required to have physical education opportunities. Seventy-two and a half percent or 37 of 51 states, require adolescents to take physical education during at least one year from grade sixth through eighth (SHAPE, 2016). Ninety percent or 46 of 51 states require high schools to offer physical education. Over three-quarters of states (44 of 51 or 86.3%), require students to participate in physical education during one of more of their years in high school. Some even expect students to earn credits in physical in order to graduate (SHAPE, 2016).

There has been a proven importance for physical activity in a child and adolescent’s life, since it is an important factor in their long-term health. The role of physical activity in a school-aged child is becoming increasingly necessary, especially with the increase in obesity across the
United States. Through the review of literature, the pros and cons to school-aged children taking part in activity will be addressed in relation to academics and other aspects of health. It is believed that taking part in physical activity can boost one’s mental health and brain activity, thus leading to improved academic performance.

**Purpose of the Study**

The purpose of this synthesis project was to research the effects that physical activity has on children’s academic achievement. Physical activity is generally believed to have a positive influence on a school-aged child’s academic achievement. The goal was to research studies that have been completed to find whether different types of physical activity have an impact on academic performance. Any potential negative impacts on academic success that may come from school-aged children participating in physical activity were addressed as well. Given the range of K-12, it is important to realize that the requirements as well as activities will differ due to age, abilities, concentration and maturation. The main forms of physical activity that will be focused on include physical activity outside of school (recreation programs), physical education, extracurricular and recess as well as classroom activities. Through exhaustive research, it was possible to build a firm platform on the relationship between physical activity and academic achievement.

**Research Questions**

1. What are the benefits of physical activity for children (physical, intellectual, social and emotional wellness)?
2. Are there any negative or neutral aspects of participating in physical activity?
3. What impact does physical activity have on the academic performance of;
   a. Elementary children?
b. Secondary children?

c. Males vs. Females?

4. What types of physical activity have the most positive impact on academic performance and how much;

   a. Physical education?

   b. Recess and classroom based physical activity?

   c. Extracurricular physical activity and sports?

**Operational Definitions**

1. Academic Performance- “Used broadly to describe many different factors that influence a student’s success within school including their academic achievement (some examples include standardized tests or grades), one’s cognitive abilities or skills (such as concentration, verbal ability, attention and memory) and lastly their academic behaviors (involving; time on task, completing homework, attendance and conduct)” (HHS-CDC, 2010).

2. Physical Activity- “Physical activity is defined as any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a resting level. Physical activity can be repetitive, structured, and planned movement (e.g., a fitness class or recreational activity such as hiking); leisurely (e.g., gardening); sports-focused (e.g., basketball, volleyball); work-related (e.g., lifting and moving boxes); or transportation-related (e.g., walking to school).” (HHS-CDC, 2010).

4. Cognitive- “Relating to, being, or involving conscious intellectual activity (such as thinking, reasoning, or remembering)” (Dictionary by Merriam-Webster: America's Most-Trusted Online Dictionary).


6. Physical Education Events- “instruction in physical exercise and games, especially in schools” (Google Definition).
   - Studies included System for Observing Fitness Instruction Time (SOFIT)

7. Recess- “Recess is a time during the school day that provides children with the opportunity for active, unstructured or structured, free play” (HHS-CDC, 2010).

Assumptions

1. The literature review was exhaustive and comprehensive.

2. Studies used methods that were valid and reliable.

3. Participants answered questions and/or participated honestly.

Delimitations


2. All articles used in the literature review were peer reviewed, databased and from academic journals.

3. All articles included school aged children ages 5-18 or grades K-12.

Limitations

1. Not all students participate in or have opportunities for the same amount of physical activity.

2. Potential for inadequate sample size in research studies to draw generalized conclusions.
Chapter 2: Methods

The purpose of this synthesis project was to examine the effects of physical activity on children’s academic performance. The aim was to determine if being physically active can increase academic achievement in K-12 students. The purpose of this chapter is to explain the methods and procedures that were utilized to find literature for this synthesis project.

The literature that was chosen for this synthesis was accessed through The College at Brockport, State University at New York’s library website. Through the databases that are provided, EBSCO host was the main search engine and from it, SPORTDiscus and Academic Search Complete were explored. All the articles that were selected for the critical mass were academic research reports, journal articles and scholarly peer reviewed articles. The Brockport interlibrary loan service was utilized for a handful of articles that the college did not originally have access to. The search required numerous variations of search terms and combinations to collect the desired content and data.

The first search, completed using Sport Discus and Academic Search Complete, was done by searching the terms; physical activity or exercise or fitness or physical exercise, academic performance, children or adolescents or youth or child or teenager. From this search, 787 articles appeared and to break down the sources to more recent research, the dates were limited to the years 2000-2017 and limited to scholarly (peer-reviewed) journals. This brought the results down to 659 and after that, articles in the English Language, source types including journals and academic journals were selected, leaving 615 articles. The first few pages of the search results were looked through to get a feel for what articles were available and if any titles applied to the topic, and the abstract and then articles were read. On the third page of results, the article titled, “Bike Desks in the Classroom: Energy Expenditure, Physical Health, Cognitive
Performance, Brain Functioning, and Academic Performance” was found. The source of the article was the *Human Kinetics Journal of Physical Activity and Health* and used mixed methods in the research. Forty-four adolescents participated in the study. Within the same search and parameters, on the fifth page, an article titled “A Mixed-Methods Evaluation of the Move It-Move It! Before-School Incentive-Based Physical Activity Programme” was found as well. This article utilized qualitative research methods and had to be received through the interlibrary loan, from the *Health Education Journal*. One hundred twenty-nine children between third and fifth grade were involved in the study. Another article pertaining to the research was found on page six, called “Relationships Between Negative Affect and Academic Achievement Among School Students: The Mediating Effects of Habituated Exercise”. This article originated in the *Journal of Physical Activity and Health*, and utilized qualitative methods. Seven hundred fifty secondary students were involved in the study, 452 were females and 258 were males. The participants were 13-14 years old. Interlibrary loan was needed to retrieve the article. The last research article that was found within this specific search on Sport Discus and Academic Search complete was “Objectively Measured Physical Activity has a Negative but Weak Association with Academic Performance in Children and Adolescents”. This was found on the sixth page of the search results and was completed using mixed methods. This research article included a total of 1,778 adolescents and children between the ages of six and eighteen. The article originated in *Acta Paediatrica* and was received through the interlibrary loan.

Sport Discus and Academic Search Complete were then used searching the key words; *physical activity or exercise or physical exercise, academic performance or academic achievement, children or adolescents or youth or child or teenager*. The original search brought up one 1,352 articles and to sift through them, the parameters including scholarly (peer
reviewed), publication between 2000 and 2017, journals and academic journals and articles in English were selected. This search brought up 1,029 articles and to begin, the first page of article titles was read through to see if there were any which had the potential to answer the research questions. The first page of the search results is where the quantitative research article titled, “Association Between Physical Activity and Academic Performance in Korean Adolescent Students” was found. The article came from the BMC Public Health Journal and there were 75,066 adolescent students who participated between grades seventh and twelfth.

The exact same search was utilized and the next few pages of articles were searched through and on the second page of the search results is where the article titled “Physical Activity and Obesity Mediate the Association Between Childhood Motor Function and Adolescents’ Academic Performance” was found from the Proceedings of the National Academy of Sciences of the USA (PANAS). This qualitative methods article seemed to fit the research very well so the interlibrary loan was utilized and the article was received through email. Eight thousand sixty-one children were involved with the study. The research article titled “Classroom-Based High Intensity Interval Activity Improves Off Task Behaviour in Primary School Students” was also found under these search parameters on the second page of the results. The article was from Applied Physiology, Nutrition, and Metabolism and utilized mixed methods. This research article included 24 fourth grade students and 20 second grade students. Another research report called, “The Combined Impact of Diet, Physical Activity, Sleep and Screen Time on Academic Achievement: A Prospective Study of Elementary School Students in Nova Scotia, Canada” was utilized from this very successful search, found on the second page as well. This mixed methods article was from the International Journal of Behavioral Nutrition and Physical Activity which included 4,253 fifth graders. A qualitative article titled “Implementation of a School-Based
Policy to Increase Physical Activity” was found on page two of the results and read through to determine that it was useful information for the research questions. The article originated in the Journal of School Health and offered useful insight to the synthesis question. The participants included 111 elementary and middle school districts. The research report, “Four Minutes of In-Class High-Intensity Interval Training Improves Selective Attention in 9 to 11-Year Old’s”, was then found on page three of the same search, by reading through article titles and abstracts if they sounded relevant to the topic. This research was from the Applied Physiology, Nutrition, and Metabolism and involved 88 students between third and fifth grades, utilizing mixed methods. The last article found within this search was a mixed methods research report from Medicine & Science in Sports and Exercise, found on page three of the search results as well, titled “Effects of Physical Education and Activity Levels on Academic Achievement in Children”. This study incorporated 216 sixth grade students.

For the next main search, the search terms used were physical activity or exercise or physical fitness or physical exercise, high school students and academic achievement or academic success or academic performance. Four hundred thirty-eight research articles initially came up as a result, so limitations to the research articles were utilized including scholarly (peer reviewed) journals, a date range of 2000-2017, source types including journals and academic journals and results in the English language. This left 330 articles and the articles were searched through to find relevant titles to the synthesis question. On the first page, the article titled “Physical Activity and Sports Team Participation: Associations with Academic Outcomes in Middle and High School Students” from the Journal of School Health appeared as a result. There were 4,746 middle and high school participants, with an approximately equal distribution between males and females. Thirty-three-point nine percent were middle schoolers and 64.8%
were high schoolers. This qualitative research report seemed like a perfect fit, so a request for an interlibrary loan was sent and the article was received through email.

Another search for articles included searching the terms *exercise, children and academic achievement*. Three hundred seventy articles appeared when searching these keywords. The search was then narrowed to scholarly (peer reviewed) journals, between the years of 2000 and 2017, articles written in English, journals and academic journals. This only brought the search results down to 302 articles, so the articles were looked through to find relevant titles. On the first page, there was an article called “Muscular and Aerobic Fitness, Working Memory, and Academic Achievement in Children” from the *Medicine & Science in Sports & Exercise*. This quantitative research article added some great information and background to the synthesis question, incorporating 93 preadolescent children.

A search utilizing the keywords; *physical activity or exercise or fitness or physical exercise or sport, secondary students or high school students and academic achievement or academic performance or academic success* was then done. A total of 607 articles came up between Sport Discus and Academic Search Complete and then to sort through them more, they were limited to 2000 through 2017, scholarly (peer reviewed) journals, written in English. The 460 search results were then put into order from oldest to newest, then were reviewed to find titles that supported the research question. On the very first page, an article titled “Academic Performance and Participation in Physical Activity by Secondary School Adolescents” was found that had supporting information for the desired age range. This article consisted of qualitative research methods and was from the *Perceptual and Motor Skills Journal*. The participants of this research study were 200 boys and girls between the ages of 13-16.
Chapter 3: Review of Literature

Fourteen articles were found that pertain to the synthesis topic of the relationship of physical activity and children’s academic achievement. The articles were categorized into five themes: 1. relationship between physical activity and academic achievement; 2. effects of physical activity on a child’s behavior and concentration levels; 3. neutral and/or negative effects of physical activity on academic achievement; 4. physical activity and the effects on academic achievement of secondary students; and 5. the effects of physical activity on elementary students. Each category will provide articles that are related to the topic and include an overall summary of what was done within each study. The two main goals of this chapter were to determine what the authors did and what they ultimately found.

Relationship Between Physical Activity and Academic Achievement

A study by Torbeyns, de Geus, Bailey, Decroix, Cutsem, De Pauw, & Meeusen (2017), titled, “Bike Desks in the Classroom: Energy Expenditure, Physical Health, Cognitive Performance, Brain Functioning, and Academic Performance” was created to investigate what the influence of having bike desks within a classroom might have on adolescents’ physical health, energy expenditure, academic performance and brain functioning. The participants included 44 adolescents over a five-month period, using a bike desk for four hours of class per week. Their energy expenditure was measured for six consecutive days. Students were randomly assigned to either an intervention group (IG) or control group (CG). All participants had aerobic fitness, academic performance, brain functioning, anthropometric parameters and cognitive performance measured before (shown by T0) and after (shown by T1) the intervention. Statistical analyses were conducted using IBM SPSS statistics and ANOVA used for repeated measures to
find differences. The Kolmogorov-Smirnov test was used to test normality of data. The data was presented as mean + or – SD, statistical significance set at P<.05.

The findings showed that energy expenditure in the intervention group was much higher during the hours that the student participants were in class and utilized the bike desks in comparison to normal class hours. The control group was found to have had quite a bit higher BMI at T1 when compared to T0, but this this was not found to be a significant difference for the intervention group. The aerobic fitness level of the intervention group at T1 versus T0 was significantly better. There were no standout effects on cognitive performance, academic performance and brain functioning that were observed. Using the bike desks did not interfere with the adolescent’s academic performance or attention in class. The authors concluded that bikes could be used as an effective way to reduce sedentary time while in class to improve students’ physical health. Having bikes in the classroom led to an increase in students’ aerobic fitness and influenced positive changes in terms of BMI. For future research, they suggested using observations instead of questionnaires to access results.

The study titled “Association Between Physical Activity and Academic Performance in Korean Adolescent Students” was completed by Wi-Young So in 2012, to explore the effects that many types of physical activity done at several different frequencies have on adolescent students in Korea. The participants in this study included 75,066 adolescent students: 34,454 females and 39,612 males, between seventh to twelfth grades. The research took place using the Korea Youth Risk Behavior Web-based Survey (KYRBWS-V) project, completed in 2009. Using data found by the survey assisted in finding potential relations between PA and academic performance in this current study. SPSS was used for statistical analysis. Multivariate logistic
regression analysis incorporated adjustments for covariate variables including BMI (body mass index), parent’s education level, age, the and the income status of the family.

The study found that in comparison to boys who did not take part in vigorous physical activity, the ones who participated two to four times a week were more likely to report either average or above average academic performance. In comparison to boys who did not take part in moderate physical activity, the ones who participated one to five times a week were more likely to report either average or above average academic performance. Boys who took part in strengthening exercises at least five times a week were less likely to report below average academic performance. In comparison to girls who did not take part in vigorous physical activity, the ones who did so five or more times a week were more likely to report either average or above average academic performance. In comparison to girls who did not take part in moderate physical activity, the ones participated two to four times a week were more likely to report either average or above average academic performance. Girls who took part in strengthening exercises at least five times a week were less likely to report below average academic performance.

In conclusion, Wi-Young concluded that Vigorous PA done at least four times a week had a positive correlation with academic performance in boys. Moderate physical activity had a positive correlation with academic performance in both adolescent Korean boys and girls. When boys take part in vigorous physical activity more than five times a week and both boys and girls take part in strengthening exercise more than five times a week, it was shown to have a negative correlation with their academic achievement. This study showed that physically active boys and girls are more likely to perform well academically in school, but too much time in physical activity could be detrimental to academics. The results of this study show that physical activity
may increase memory and brain function. Moderate physical activity does have a positive effect on both boys and girl’s academic performance.

Evenson, Ballard, Lee & Ammerman wrote an article titled, “Implementation of a School-Based State Policy to Increase Physical Activity” in 2009, with the purpose being to describe how districts across North Carolina worked to meet the physical activity portion of a Healthy Active Children Policy. They explored the implementation of the policy as well as any successes or challenges. In the Summer of 2007, an online survey was conducted that received a 96% response rate (106 of 111 individuals responded). The North Carolina School System consisted of 2,084 schools in 115 districts during the 2007-2008 school year, of these, four combine city and county school district responses on the survey for 111 school districts total. Elementary and middle school aged students participated in the study. Participants were asked to describe any successes as well as challenges in the implementation of having 30 minutes of physical activity during the school day. In terms of data analysis, the online survey’s answers were coded and grouped into themes.

The results found within this study conclude that many positive effects were reported due to the policy within elementary and middle schools. The physical activity requirement was typically fulfilled through recess, intramural sports or energizers done in the classroom. The benefits that were perceived by this were; increased student focus on studies, increased physical activity participation, increased alertness, increased enjoyment as well as an increased awareness of healthy habits. Some of the challenges that arose from this program include teacher participation due to them believing that there was a lack of time during the school day and concerns that it took too much time away from academics. The conclusions that were drawn conclude that implementation of the policy produced many positive results for the students and
the staff. Also, they found that it would be necessary to address the challenges to implementation that were common across the school districts in North Carolina to help to the future success of the policy.

**Effects of Physical Activity on a Child’s Behavior and Concentration Levels**

Ma, Le Mare and Gurd conducted their research in 2015, titled “Four Minutes of In-Class High-Intensity Interval Activity Improves Selective Attention in 9- to 11-Year Old’s”. The purpose of their study was to find out whether FUNtervals can increase one’s selective attention. FUNtervals are described as time-efficient physical activity breaks that do not require any equipment and can be done within a classroom. The authors were trying to determine whether academic success can be predicted by students’ classroom off-task behavior. They aimed to find physical activity that is time-efficient that would demonstrate a positive impact on one’s academic achievement to show the need for physical activity within a curriculum, since the amount of time dedicated to physical activity in schools is on the decline. Seven third to fifth classes, totaling 88 students were put into one of three intervention groups. The groups included 1) FUNterval and no activity intervention 2) FUNterval activity intervention or 3) no physical activity intervention. The D2 test for attention is a standardized test accessing one’s concentration and attention related to academic performance. Classroom observations took place throughout the research study. In the first week, the children were opened up to the d2 test which was for attention; the activities FUNterval was included and the children’s baseline off-task behavior was observed. In the second and third weeks, the students took part in the test of attention after finishing a no-activity break or a FUNterval break. The order that the breaks were put into was switched up and were not the same week to week.
The results were broken down into different categories: sex differences, intervention effects on attention and off-task behavior and selective attention. On no-activity days, males made a higher number of total errors and errors of commission than females in off-task behavior. Males also participated more in a larger percentage of passive and motor off-task behavior than females did. In terms of the effects of the intervention on a child’s attention, the results were that all parts to the d2 test improved from the first to the second week. Test day order was found to have a significant impact from the first day to the second day in all of the d2 test results. The same was found to be true between the third and the fourth day as well. The participants’ off task behavior and selective attention was evaluated using simple linear regression tests. It was found that motor off-task behaviors as well as baseline passive behaviors were not found to predict the adjustments in the d2 test outcomes. Some examples of this is the apparent difference that was found between the no activity d2 test performance and FUNterval. The most vital finding was that that 4 min of high-intensity interval activity improves selective attention in elementary school children. Short, high-intensity interval exercise (FUNtervals) were shown to improve selective attention in nine to eleven-year olds. Off-task classroom behavior that occurs verbally, weakly anticipated the adaptations in one’s selective attention by influence of FUNtervals. When passive and motor off-task behaviors were detected, a similar association was not found. The results conclude that FUNtervals can help to boost one’s performance on a selective attention test. This may also reveal that FUNtervals can improve the learning environment in-class, since they are easy to execute.

Ma, Le Mare and Gurd also wrote “Classroom-Based High-Intensity Interval Activity Improves Off-Task Behaviour in Primary School Students” in 2014, based around their research which aimed to investigate the effects of an acute bout of quick high intensity interval training
(HIIT) exercises have on off-task behaviors in young grade school children. These HIIT workouts were FUNtervals which are quick bouts of exercise which do not require any equipment. A fourth-grade class (24 students) and second grade class (20 students) were introduced to either an active break that consisted of FUNtervals HIIT on alternating days for three weeks or a no-activity break. The no activity days included a ten-minute inactive break while FUNtervals had a four-minute FUNterval with a ten-minute break from normal class activities. Data analysis was completed by using paired samples t-test- to compare mean-off task behavior between no activity days and FUNtervals.

The findings were that there was no significant correlation that was detected between the decrease in off-task behavior and the participation scores for FUNterval activity as a result of taking part in FUNtervals. The conclusions from this study included that performance of FUNtervals, a quick HIIT workout, in second and fourth grade classrooms results in a decrease in students’ off-task behavior. This effect was most prominent in the students who demonstrated the most off-task behaviors on nonactivity days. The results show that the FUNtervals workout was incorporated into elementary classrooms and demonstrated the effectiveness of a very quick physical activity break in order to assist in decreasing off-task classroom behavior.

Faught, Ekwaru., Gleddie, Store, Asbridge, & Veugelers (2017) wrote an article titled “The Combined Impact of Diet, Physical Activity, Sleep and Screen Time on Academic Achievement: A Prospective Study of Elementary School Students in Nova Scotia, Canada”. This study explored whether or not the combined effect of diet, physical activity, sleep and screen time would have a higher impact on academic achievement than any other behavior alone, or weight status. The research took place in Nova Scotia, where 4,252 fifth grade students and their parents were surveyed on what the child’s diet was like along with sleep patterns, “screen
time” and physical activity levels. The participants’ heights and weight were measured and their academic achievement was measured using exams in math, writing and reading and was graded based on ‘meeting’ or ‘not meeting’ expectations of the standardized criteria. Yes and no was utilized to measure whether recommendations were met when it came to lifestyle behaviors and self- and parental proxy. Data analysis was completed by utilization of standardized tests, self and parental proxy reports and mixed effects regression models.

It was found that when a participant met the dietary recommendations, this was ultimately associated with heightened likelihood that they would meet the academic expectations that exist for each test in math, reading and writing. One interesting finding was that when a child met the recommendations for either sleep or screen time, this was correlated with them meeting expectations for writing. When it came to the three academic subjects, an individual’s ability to meet added lifestyle behavior recommendations had a correlation with an increased probability of them meeting the expectations on the exam. If a child met with seven to nine of the lifestyle behavior recommendation’s, they were found to have higher than three-times the odds of meeting the anticipated results for reading expectations when they were compared with scores of the participants who met zero to three of the recommendations. Conclusions that were drawn are that lifestyle behaviors (not body weight) are strongly associated with student academic performance. Promoting compliance with healthy lifestyle recommendations can boost both educational and health outcomes in children. School based health programs that target many lifestyle behaviors have a more powerful effect than the ones who focus on a single behavior.

An article titled “Physical Activity and Obesity Mediate the Association Between Childhood Motor Function and Adolescents’ Academic Achievement” was written in 2013 by Kantomaa, Stamatakis, Kankaanpää, Kaakinen, Rodriguezb, Taanilae, Ahonen, Järvelin &
Tammelina. This study took place in Northern Finland and explored whether motor function in childhood determines academic achievement through obesity, fitness and physical activity in the future. The participants included 8,061 children from the Northern Finland Birth Cohort from 1986. The Northern Finland Birth Cohort data consisted of parent-reported motor function at eight years old and self-reported physical activity, predicted cardiorespiratory fitness (including cycle ergometer test), academic achievement (grades) at 16 years old, obesity (body weight and height). Analysis of the data was done through structural equation models which included standardized (β), as well as unstandardized (B) coefficients. They were utilized to determine if and to what extent cardiorespiratory fitness, obesity by the age of 16 and physical activity fitness, had an association between an adolescent’s academic achievement and their childhood motor function.

Results from this research study show that the children taking part in physical activity had a higher grade-point average. It was found that obesity had a relationship with a student having a lower grade-point average during their adolescence. Compromised motor function in one’s childhood was shown to have a negative indirect effect on an adolescent’s academic achievement via physical activity. The results suggest that obesity and physical activity may mediate the association between adolescents’ academic achievement and childhood motor function.

Neutral and/or Negative Effects of Physical Activity on Academic Achievement

Kao, Westfall, Parks, Pontifex & Hillman collectively studied to write “Muscular and Aerobic Fitness, Working Memory, and Academic Achievement in Children” in 2016. One hundred thirty-five preadolescent children were contacted between November of 2013 and September of 2014. Ninety-three children participated in the study after they were found to be
free of attention deficit hyperactivity disorder or neurological disease, were capable of performing exercise according to a pre-exercise screening and were not enrolled in an educational program that was individualized (IEP). Written consent was gained from each participant’s parent or legal guardian. All children were administered the Kaufman Brief Intelligence Test, second edition to conclude with an estimated IQ. They then went on to measure the children’s BMI, weight, height as well as muscular and aerobic fitness.

VO\textsubscript{2 Max} was measured for the aerobic fitness assessment by using a computerized indirect calorimetry system. Polar heart rate monitors were worn by the students. Maximum effort was based on four confidence criteria which included reaching a plateau in oxygen consumption (despite an increased workload), a peak heart rate at or 185; and a child rated perceived exertion as at or above an 8. The muscular fitness assessment consisted of a full body assessment involving the core, upper body and lower body. Participants were asked to complete as many reps as possible in 30 seconds with proper form at a comfortable weight. The cognitive task included an n-back test presented to the participants with a sequence of many different stimuli on a computer. Subjects were instructed to answer as accurately and quickly as possible using different prompts. Academic Achievement was testing utilizing the reading test and included two categories that were 1. written conventions and 2. reading comprehension. The math tests included three different types of questions: 1. functions and algebra; 2. addition, subtraction, multiplication, and division; 3. geometry and measure. Children who were younger than nine and half years, took the third to fourth grade edition of the tests and participants older than nine and a half years took the fourth to fifth grade edition. They were given 15 minutes to complete the tests.
Written consent was obtained from parents or legal guardians. Demographic questionnaires as well as K-BIT and academic achievement tests were completed. All participants were given 72 practice runs of the n-back test for each condition. From there, a 30-minute rest was given between the muscular fitness and the aerobic fitness assessment. The second day of testing they completed a computerized n-back test after 20 practice runs at each condition of the n-back test.

Data was analyzed using SPSS. Bivariate correlations were completed to compare fitness indices, performance of the academic achievement test, demographic variables as well as n-back tasks performance measures across 1 and 2 back conditions. Linear hierarchical regression analyses were completed using aerobic or muscular fitness measures that were closely correlated with academic achievement or utilizing working memory. The measures of working memory were assessed using an ANOVA 2x2 repeated measures analysis. The final sample comprised of 79 people. This excluded the individuals who had an IQ lower than eighty, did not reach a VO2 Max plateau or two other confidence criteria during their aerobic fitness assessment, received less than a 50% in their responses to the n-back test.

The results indicated that after controlling for demographic variables, such as grade, sex, IQ, socioeconomic status and age, the children taking part in aerobic fitness activities had an association with having an increase in correct responses on the two-back condition and earned higher math scores, with better performance on algebraic functions. The children’s muscular fitness was found to have a relationship with an increase in accuracy of their responses and the two-back condition strictly stemmed from aerobic fitness. In conclusion, the findings suggest that there are differing results when it comes to the relationship between muscular and aerobic physical fitness with one’s academic achievement or working memory. The research was based
mainly around the benefits of children taking part in aerobic fitness, but in conclusion they suggest that muscular fitness is also an important factor in one’s cognitive health during preadolescent years.

Esteban-Cornejo, Tejero-González, Maria, Martinez-Gomez, Cabanas-Sánchez, Fernández-Santos, Conde-Caveda, & Veiga, completed a study in 2014 titled, “Objectively Measured Physical Activity has a Negative but Weak Association with Academic Performance in Children and Adolescents”. The authors sought to discover the relationship between academic performance and objectively measured physical activity using a large group of children and adolescents. The purpose of this study was to access the long-term impact of sedentary behaviors and physical activity on health indicators. The analysis involved a total of 1,778 adolescents and children for whom the authors had total baseline data in terms of academic performance, maternal education level and objectively measured physical activity. Data was collected between September of 2011 and June 2012. The participants were between the ages of six and eighteen from schools located in Madrid and Cadiz. These schools participated in the three-year longitudinal UP & DOWN study. The measurements of the study included physical activity, academic performance and covariates. Physical activity was objectively measured by utilizing three different versions of the ActiGraph accelerometer, which are designed to detect vertical accelerations of different magnitudes. Each participant was to wear the accelerometer on their low back for seven days in a row. They were only to remove it during sleep or activities in the water. The relevant criteria to be included was recorded activity for at least ten hours per day, three out of the seven days. Academic performance was evaluated using school records at the completion of the school year. There were four main indicators that were utilized including grade point average, language, mathematics and the average of the two core subjects. Letter grades
were converted to numerical values, A=5, B=4, C=3, D=2, F=1. The participants’ sex, age and maternal education level was recorded. Body mass index was calculated doing the individuals’ weight in kilograms divided by their height in meters squared. The student’s cardiorespiratory fitness was tested by taking part in the 20-meter shuttle run, where their score was the number of stages they finished. Their motor fitness was tested by completing four, ten-meter shuttle runs. This test determined their levels agility, coordination and speed-of-movement. The fitness scores of the participants were calculated by finding the mean of the two standardized test scores.

The results indicated that physical activity was found to have an inverse relationship with all academic performance indicators. The association of academic performance and objectively measured physical activity became insignificant within the physical activity quartiles. There were very few distinctions in the academic performance of the lowest and the second quartile of physical activity when they were compared to that of the highest quartile. The results of this study may indicate that adolescents’ and children who are more physically active, spend less time studying. The researchers concluded that objectively measured physical activity may have the ability to influence academic performance in adolescents’ and children. The association that was found was very weak and very negative. More intervention and longitudinal studies are needed to understand the participant changes over a period of time when it comes to academic performance and physical activity during an individual’s adolescence or childhood.

Physical Activity and the Effects on Academic Achievement of Secondary Students

Daley and Ryan (2000) wrote about a study that they did titled, “Academic Performance and Participation in Physical Activity by Secondary School Adolescents”. This was completed with the purpose of researching the relationship that exists between an adolescent’s participation in physical activity and academic performance. The study consisted of 232 boys and girls
between the ages of thirteen and sixteen years old who attended a catholic comprehensive school that was located in southwest England. Three of the classes were randomly selected from grades eight (60 participants), nine (60 participants), ten (55 participants) and eleven (50 participants). The number of boys and girls was approximately equal. The results that were compiled include grades of the students in grades eight through eleven, from the common core classes including math, English and science. Grades were recorded as A=5, B=4, C=3, D=2, E=1 when collected at the end of the year. Students took part in a modified version of the Physical Activity Participation Questionnaire where they were asked to list the typical amount of days they participate in physical activity per week as well as the amount of time they typically do so. This included all types of sports or physical activities that they take part in during a normal week during or even after school. Before data was collected, Daley and Ryan completed a pilot study which included an eighth-grade class to make sure the process of the study was smooth. Data collection for physical activity and academic performance was not recorded at the same time in the year, therefore a relationship cannot be drawn. Grades were drawn from the end of the year examinations which tests for the core subjects, however this typically causes an increase in study time and a decrease in physical activity for the duration of the examination period.

The correlations that were made between participation in physical activity (frequency and minutes) and academic performance did not support the hypothesis that was made for the study. The findings suggested that participants who were ages 13, 14 and 16 showed a weak, negative correlation between the number of minutes spent taking part in exercise and sport with the English grades. There was a similar relationship with sixteen-year olds and science scores. In conclusion, there was not a significant association between academic ability and physical activity so assumptions cannot be made. The data showed that exercise and sport may have a negative
effect on one’s academic attainment, but the samples were relatively small so there was not an extreme focus on negative correlations. Students who attend the school need to get permission from the priest. Therefore, the grades of the students tended to weigh more on the higher side which very well could have restricted the variability that exists within the scores of performances.

The research article, “Relationships Between Negative Affect and Academic Achievement Among Secondary School Students: The Mediating Effects of Habituated Exercise” was written by Hashim, Golok & Rosmatunisah in 2012. The purpose of this study was to examine the associations that exists between stress, depression, anxiety, exercise habit and academic achievement in adolescents. Seven hundred fifty secondary school students were involved in this study, 452 boys and 258 girls. All students were randomly selected from three different schools from an eastern state in Malaysia. Each participant was 13 or 14 years old. Sixty percent were 13 years and 20% were 14 years. When broken down into ethnicities, 0.4 percent were Chinese, 0.5% were Indian, 98.8% were Malaysian and 0.3% identified with other ethnic groups. The student’s participation in the study was voluntary. Parents and guardians were given information and consent forms to be signed for the participants. Students who were given permission to participate were given a questionnaire, which on average, took about ten minutes to finish.

Four instruments were used for measurements within this study, including the exercise habit strength questionnaire, Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2), Depression Anxiety Stress Scale-21 (DASS-21) and academic performance, all measured using Likert-scale questionnaires. The exercise habit strength instrument used an 18-item questionnaire which asked about the student’s exercise habits. They had to answer questions about their
feelings toward exercise and reflect, using a six-point Likert scale. The questions branch into four different dimensions which include stimulus cue, patterned action, automaticity and negative consequences, which were set to represent their habits and behaviors. The students’ exercise motivation was measured by the use of the BREQ-2. The statements reflect the reasons why an individual does or does not chose to take part in physical exercise, using a five-point Likert Scale, zero being not true for them to five being very true for them. The DASS-21 scale was used to measure the children’s stress level as well as anxiety and depression. On this questionnaire, participants had to respond to the extent that the statements applied to them during the past week. The responses were rated on a four-point Likert Scale which ranged from 0 to three, not applying to them at all to applying to them all the time. Academic performance was based on the results of a midyear exam where each student sat for tests in eight subjects. Data that was received from the school was transferred to numerical data and averaged, A=1, B=2, C=3, D=4, E=5, F=6.

In this study, a lower GPA represents better academic performance. A negative correlation between academic achievement and exercise habits signifies that a higher habit is correlated with better academic performance. On the other hand, a positive correlation shows that the higher the negative effect is (such as anxiety, stress or depression) the lower the academic performance is. Structural Equation Modeling (SEM) was the form of data analysis for this study. The variables for the SEM models are either observed or latent variables. This analysis recognizes error in measurement of observed variables so the relationships of latent variables are estimated. Two models were tested. Model 1 showed that habituated exercise is positively related to a higher level of self-determination. Model 2 is similar except for the correlated terms including anxiety, depression and stress factors.
The results that came from the structural equation modeling agreed with the hypothesized model. This indicated that high levels of self-determination were found to be positively related with habituated exercise behavior. It was found that exercise habit levels encouraged academic achievement and neutralized the negative effects of anxiety, stress and depression on a student’s academic performance. This model revealed that there was an insignificant difference between male and female participants. The study concludes that taking part in habituated exercise supports academic performance and helps to lower the negative side effects that may come with anxiety, stress or depression and have on one’s academic performance. The results of this study indicate that high school boys and girls and middle school boys sports team participation had a relationship with a higher GPA. Performing an increased amount of moderate to vigorous physical activity was related to having a higher GPA boys and girls in middle school as well as boys in high school. For high school boys, it was found that only participation in sports teams, but not moderate to vigorous physical activity, was correlated with a higher GPA. When it came to middle school students, including both males and females, the relationship between taking part in moderate to vigorous physical activity for an increased amount of time and having a higher GPA could not be divided from the positive association that sports team participation had with academic outcomes. A notable strength of the study was that the data distinguished between participation in sports teams and physical activity. This allowed for divided inspection of the contribution that each variable had in relation to academic outcomes. The study supported the idea that, physical activity also has a positive impact on academic performance as an addition to the variety of health benefits it offers. Further research is needed to address the nature of the culture of academics when it comes to athletes versus non-athletes and how it ultimately contributes to a student’s academic success.
The purpose of the study by Fox, Barr-Anderson, Neumark-Sztainer & Wall (2010) was to examine the commonalities that exist between physical activity or participating on a sports team and the academic outcomes of middle and high schoolers. Their work was titled, “Physical Activity and Sports Team Participation: Associations with Academic Outcomes in Middle School and High School Students”. Data was collected from 7,746 middle and high school students. The participants each attended a school in the Minneapolis or St. Paul metropolitan area of Minnesota. There were 31 schools involved in the data collection and there was almost an equal participation of females (49.7 percent) and males (50.1 percent). The breakdown of middle school versus high school participation was 33.9 percent and 64.8 percent, respectively. There was a diverse break in socioeconomic status, that included 13.7 percent with a high SES, 23.4 percent with an upper-middle SES, 26.5 percent with a middle SES, 18.9 percent with a lower-middle SES and 17.5 percent with a low SES. The breakdown of ethnic and racial backgrounds included 19.0 % African American, 19.2% Asian American, 28.5% white, 3.5% Native American and 3.9% other or mixed. Data was collected during the 1998-1999 school year. Parental consent was required by 14 of the schools, while the other 17 approved with passive parental consent. Data was collected through the survey in Physical Education, Health and or Science classes in two 50-minute periods or one 90-minute period. The only instrument used was the Eating Among Teens survey (EAT) to access eating behaviors, weight-related issues and aspects of adolescent health. This was a 221-item survey. Questions on sociodemographic variables were asked including race, ethnicity and socioeconomic status. Participants were also asked about their sport team participation, simply how many teams they had been involved in within the past 12 months. The students were then asked how many hours they spend participating in vigorous activity (quick heart beat), moderate (not extremely exhausting) and
mild (low amount of effort). Grades were recorded by asking the students to mark the two main grades they receive the most- A, B, C, D, F. The letter grades were coded as follows; A=4.0, B=3.0, C=2.0, D=1.0 and the two grades marked by each individual were averaged into their grade point average. In model 1, two separate multiple regression analyses were utilized with grade point average being the outcome variable. The individual’s participation in a sports team or moderate to vigorous physical activity hours were used as the predictor. Socioeconomic status, ethnicity and race were controlled. T tests were done by the multiple regressions which aimed to find the differences in grade point average based on participation in a sports team and moderate to vigorous physical activity.

The results indicated that both sports team participation and physical activity were each independently associated with a higher-grade point average for high school girls. Only participation in a sports team was independently associated with the participant having a higher-grade point average for high school boys. The positive association between grade point average and physical activity was not able to be separated from the relationship that exists with grade point average and participation in a sports team. The findings of this study indicated that there is a positive association between academic achievement and physical activity involvement among students.

**The Effects of Physical Activity on Elementary Level Students**

Garnett, Becker, Vierling, Gleason, DiCenzo, & Mongeon’s study (2013), titled, “A Mixed-Methods Evaluation of the ‘Move It Move It!’ Before-School Incentive-Cased Physical Activity Programme” was designed to determine the impact of a before and after school program incorporating physical activity on student grades and behavior. The main goal of this initiative was to create a community, assist in getting students ready to learn and boost fitness levels. The
study took place in Burlington, Vermont, where self-reported surveys were given to all students who had consent. All parents/guardians were given a flyer with information and they utilized an opt-out approach. Participants consisted of students between third and fifth grades at the Integrated Arts Academy (IAA) in Vermont. The pool was made up of 129 children. Interviews were done with school officials in a semi-structured manner with the team who created the program (five individuals). Qualitative interviews were completed to follow up with the quantitative survey, making this a mixed methods pilot feasibility study. Descriptive statistics for all of the variables were calculated. Analyses were completed to find correlations and bivariate associations. Chi-square tests were used to find any associations that existed. Analysis of variance was utilized to look into the relationship between the mean number of miles walked or run and bullying behaviors. Linear regression analyses were conducted to find the association between academic achievement and the “Move It Move It” miles that were run or walked to predict the scores of the New England Common Assessment Program mathematics testing scores. The qualitative data was transcribed and codes were given to portions of the qualitative interviews which supported the main focus of the study. Hierarchical codes were then created in order to organize the major themes. The frequency of the codes and interactions were compared between the interviews that took place in order to identify any major themes that became apparent. This was utilized to determine whether or not the themes aligned with pre-determined hypotheses. Data was analyzed using Dedoose which is an online software program that specializes in mixed-methods research.

During 2013-2014, 41% of the participants were found to be proficient when it came to the NECAP exam testing for reading and 51% of the students who took part in the study were found to be proficient on the mathematics exam. The average amount of miles that were walked
by the students was 20 throughout the program. The boys were found to have walked more, averaging 28.5 miles and the girls averaged 13.2 miles. The boys who were in this study reported higher difficulty completing school related tasks (involving their self-regulation and self-efficacy). The boys also reported more engagement in bullying-like behaviors when compared to the girls. Girls reported having higher levels of commitment to school when compared to the boys. According to the results of the multivariable linear regression models which show the NECAP mathematics scores with the commitment to school, the miles that were walked by the students were shown to be a significant positive influence with their NACEP mathematics scores. According to the bivariate model, it was shown that a one-mile increase in miles that were either run or walked, directly related with a slight but significant increase in the math scores, which was maintained after controlling for gender. From the qualitative interviews, completed with the school staff, responses were broken down and organized into four main themes that signify the impact that the program had on the participants. These themes included: the school’s climate and the community within the building, academic learning, the student’s behavior and the importance of the incentives that were shown in initiating and completing the program. The results of this community based initiative demonstrated a positive effect on behavioral and academic outcomes. This was associated with students engaging in the before-school physical activity program which provided incentive for the students. Future replication of the studies is required in order to confirm that the program is effective in a variety of communities. It is important to realize that the incentives and rewards are significant motivators to a student population.

Podulka-Coe, Pivarnik, Womack, Reeves, & Malina (2006), wrote research titled, “Effects of Physical Education and Activity Levels on Academic Achievement in Children”. The
The purpose of this study was to determine what the effect of enrollment in physical education classes had on middle school aged students’ academic achievement. Two hundred sixteen sixth grade students at a school in Michigan participated in the study. The average income of the school is higher than that of Michigan as a whole. A packet with information and consent forms was sent home with students and participation was voluntary. Students were assigned to a team which had a teacher from each core course. They were randomly assigned for a semester. One group was assigned to take physical education during the first semester and the other group was assigned to take it the second. During the semester the student didn’t take the PE class, they were enrolled in an exploratory class such as computers or art. The instruments that were utilized were anthropometry, physical activity recall, academic achievement and SOFIT (System for Observing Fitness Instruction Time). When measuring for anthropometry, height was measured to nearest millimeter with a field anthropometer. Weight was measured to the closest .1 kilogram and BMI was calculated. To fulfill the Physical Activity recall, habitual physical activity was estimated using the 3-d physical activity recall that asks the child about their activity for the past three consecutive days. MET values for each activity within the questionnaire were assigned depending on the intensity of the activity. The 30-minute blocks of activity were changed over to ordinal data, such as a score 1-3 (no activity, some activity or meets the healthy people guidelines 2010, respectively). Academic Achievement was based on the students’ grades in core classes, A=5, B=4, C=3, D=2, F=1. First semester grades reported in both November and January, second semester grades reported in April and June. SOFIT was done in physical education classes being directly observed by researchers and student activity levels were recorded and qualitative evaluations were performed. A paired t-test was utilized for a comparison of age, anthropometric and demographic characteristics between semester groups.
The use of the Sharpio-Wilk test results displayed that the outcome variables, including both grades and the Terra Nova Scores, were not normally distributed. The differences in academic achievement were assessed using the Kruskall-Wallis analysis. The authors sought to determine whether there were differences in academic achievement based on the semester students enrolled in physical education and their level of physical activity.

Results indicated that the only significant difference between the groups was their BMI. No pre-test data was available so the only thing they had to base it on was the midpoint (end of the first semester) and the posttest which was done at the end of the second semester. The combined academic achievement scores were not affected by enrolling in a physical education class. The Terra Nova Standardized test scores were not shown to have any affect from students being involved in physical activity. First Semester scores were 55.3 +/- 27.5 and second semester scores were 60.6 +/-20.3. Students who took part in vigorous physical activity to a point where they met or surpassed the requirement for the healthy people 2010 guidelines achieved scores that ranked higher than other students in both the first or the second semesters. No stand out differences were discovered in academic achievement or Terra Nova scores due to physical activity during either semester. A student’s enrollment in a physical education course did not affect their academic grades or performance in their core classes. Perhaps being involved in moderate to vigorous physical activity for an average of only 19 minutes of the 55-minute-long class involved is not a sufficient amount of activity time to influence a student’s academic achievement. Students who were enrolled in a physical education class during the study were not shown to have performed better in terms of academics in comparison to the students who had those 55 minutes in a classroom. The decreased time spent in the classroom though, did not translate into lower academic performance either. Rises in academic performance are related to
vigorous activity, but not moderate physical activity in the present analyses. Moderate physical activity by the sixth-grade students did not have an effect on academic achievement yet a notable relationship was found to exist between academic achievement and vigorous activity. In the first semester, when the participants took part in any quantity of vigorous activity, they were shown to have performed better academically when compared to the students who did not do any vigorous activity. During the second semester, only the participants who met or exceeded the amount of vigorous activity in the 2010 Healthy People recommendations, demonstrated a higher level academically when compared to students who did a small amount or no vigorous activity. Scores of standardized tests were examined within the study and The Terra Nova test was given during April of the second semester. The results were found to be highly significant, but the standardized test scores were found to be just about 10% higher for students who were taking physical education class during their first semester when compared to the students in physical education during the second semester. Therefore, a minimum activity intensity may be necessary to elicit changes in the child that could lead to an increase in academic achievement.

Participation in sports may provide a sufficient level of intensity to obtain the necessary threshold to see desirable results of physical activity on academic achievement and fitness. There is also a potential influence that socioeconomic status may have on the association between academic achievement and vigorous physical activity and therefore cannot be ruled out.
Chapter 4: Discussion

This chapter serves as a synthesis and discussion of the results from the review of literature on whether the benefits of physical activity for children justify time away from academics. The discussion will be based on the research questions that were presented in chapter one. Agreements and disagreements between the findings of the research studies will be addressed.

What are the benefits of physical activity for children (physical, cognitive or behavioral)?

Physical

The results of the study completed by Hashim, Golok & Rosmatunis (2012), supported the idea that physical activity has a positive impact on academic performance as an addition to the variety of health benefits it offers. The research done by Kantomaa, Stamatakis, Kankaanpää, Kaakinen, Rodriguez, Taanila, Ahonen, Järvelin & Tammelina (2013) found that taking part in physical activity was ultimately related to children obtaining a higher grade-point average. It was also concluded that a child experiencing compromised motor function during their childhood was shown to have a negative indirect effect on an adolescent’s academic achievement via physical activity.

Fox, Barr-Anderson, Neumark-Sztainer, Wall (2010) concluded that both sports team participation and physical activity were each independently associated with a higher GPA for high school girls. Only participation on a sports team was independently associated with the participant having a higher GPA for high school boys. The findings of the research by Kao, Westfall, Parks, Pontifex, Hillman (2016) suggested that there are differing results when it comes to the relationship between muscular and aerobic physical fitness with one’s academic achievement or working memory.
Cognitive

According to the 2014 study finished by Ma, Le Mare, & Gurd, short, high-intensity interval exercise (FUNtervals) were shown to improve selective attention in 9- to 11-year olds. Evenson, Ballard, Lee, & Ammerman (2009) concluded that physical activity produced an increase in the student’s focus on academics, enjoyment, and participation in physical activity, being more alert and mindful of healthy choices (Evenson, et. Al., 2009).

The research done in 2016 by Kao, Westfall, Parks, Pontifex & Hillman, was based mainly around the benefits of children taking part in aerobic fitness. In conclusion, they suggest that muscular fitness is an important factor to one’s cognitive health during their preadolescent years. The study by Hashim, Golok & Rosmatunisah, in 2012 concludes that taking part in habituated exercise supports academic performance and helps to lower the negative side effects that anxiety, stress or depression can have on a child’s academic performance.

Behavioral

The results of the community based initiative that was carried out by Garnett, Becker, Vierling, Gleason, DiCenzo, & Mongeon (2017) utilized a pilot study to find how a before and after school program incorporating physical activity, effected the students’ grades in academics and behavior. The main goal of this initiative was to create a community, assist in getting students ready to learn and boost fitness levels. As a result, it was demonstrated that physical activity has a positive effect on behavioral and academic outcomes. The results that came of the structural equation model created by Hashim, Golok & Rosmatunisah (2012) agreed with the hypothesized model that predicted that exercise habit strength would foster academic achievement. The effect of depression, stress and anxiety were expected to represent a negative effect on academic performance. In addition, it was also hypothesized that an exercise routine
would assist in moderating any debilitative effects that depression, stress or anxiety had on a child’s academic performance. In conclusion, it was found that high levels of physical activity promote self-determination and academic achievement and were positively related with habituated exercise behavior.

The study completed by Ma, Le Mare, & Gurd, (2014) found that performance of FUNtervals, a quick HIIT workout in second and fourth grade classrooms resulted in a decrease in childrens’ off-task behavior and the effect was most prominent in the students demonstrated the most off-task behaviors on non-activity days. The existing study also found that off-task classroom behavior that occurs verbally weakly anticipated the adaptations in one’s selective attention by influence of FUNtervals. When passive and motor off-task behaviors were detected, a similar association was not found (Ma, et. Al., 2014).

Are there any negative or neutral aspects of participating in physical activity?

The results of the study by Esteban-Cornejo, Tejero-González, Martinez-Gomez, Cabanas-Sánchez, Fernández-Santos, Conde-Caveda, Sallis & Veiga, (2014) sought to discover the relationship between academic performance and objectively measured physical activity. They used a large group of children and adolescents seeking to determine whether adolescents and children who were more physically active spend less time studying. The researchers concluded that objectively measured physical activity may have the ability to influence academic performance in adolescents and children. The association that was found was very weak and very negative (Esteban-Cornejo, I., et. Al., 2014). Intervention and longitudinal studies are needed to understand the participant changes over a period of time when it comes to academic performance and physical activity during an individual’s adolescence or childhood (Esteban-Cornejo, I., et. Al., 2014). In the article completed by So (2012), it was found that when boys take part in
vigorous physical activity more than 5 times a week and both boys and girls take part in strength training exercises more than five times a week, there was a negative correlation with academic achievement.

Daley and Ryan (2000) found a weak negative correlation between the number of minutes spent taking part in exercise and sport with English scores of children 13, 14 and 16. There was a similar relationship with 16-year olds and science scores. There was not a significant association between academic ability with physical activity therefore no assumptions can be made (Daley & Ryan, 2000). The data shows that exercise and sport may have a negative effect on one’s academic attainment, but the samples were relatively small so there was not a high on negative correlation (Daley & Ryan, 2000). The boys who were in the study completed by Garnett, Becker, Vierling, Gleason, DiCenzo, & Mongeon (2017) reported higher difficulty completing school related tasks (involving their self-regulation and self-efficacy). The boys also reported more engagement in bullying like behaviors when compared to the girls.

According to the results of the study done by Podulka-Coe, Pivarnik, Womack, Reeves & Malina (2006), a student’s enrollment in a physical education course did not affect their academic grades or performance in their core classes. Students who were enrolled in a physical education class during the study were not shown to have performed better in terms of academics in comparison to the students who spent those fifty-five minutes in a classroom (Podulka-Coe, et. Al., 2006). The decreased time spent in the classroom, did not translate into lower academic performance (Podulka-Coe, et. Al., 2006). The performed amount of moderate physical by the sixth-grade students did not have an effect on academic achievement (Podulka-Coe, et. Al., 2006). The results were not found to be highly significant, but the standardized test scores were found to be just about 10% higher for students who were taking physical education class during
their first semester when compared to the students in physical education during the second semester (Podulka-Coe, et. Al., 2006).

Kao, Westfall, Parks, Pontifex & Hillman (2016) concluded that physical education class enrollment status did not influence academic achievement in core classes. Using the System for Observing Fitness Instruction Time (SOFIT), they determined that an average of 19 min of the 55-min class period was spent in moderate to vigorous activity (Kao, et. Al., 2016). This low level of activity may not provide sufficient stimulation to influence academic achievement (Kao, et. Al., 2016).

**What impact does physical activity have on the academic performance of:**

a. **Elementary children?**

b. **Secondary children?**

c. **Males vs. Females?**

**Elementary**

The research completed by Ma, Le Mare, & Gurd, in 2014 shows that the FUNtervals workout was incorporated into elementary classrooms while also displaying the effectiveness of a very quick physical activity break in order to assist in decreasing off-task classroom behavior. This intervention and quick bout of exercise only took four minutes (Ma, et. Al., 2014).

A study by Faught, Ekwaru, Gleddie, Store, Asbridge, & Veugelers (2017) concluded that when it came to the three subjects of math, writing and reading, an individual’s ability to meet added lifestyle behavior recommendations had a correlation with an increased probability of them meeting the expectations which were set for their academics. If a child met with seven to nine of the lifestyle behavior recommendations, they were found to have higher than three-times the odds of meeting the anticipated results for reading expectations when they were compared to
the scores of the participants who met zero to three of the recommendations (Faught, et. Al., 2017). The authors found that promoting compliance with healthy lifestyle recommendations can boost both educational and health outcomes in children (Faught, et. Al., 2017). School based health programs that target many lifestyle behaviors have a more powerful effect than the ones who focus on a single behavior (Faught, et. Al., 2017).

In 2013, Garnett, Becker, Vierling, Gleason, DiCenzo, & Mongeon found that 41% of the children who participated in the ‘Move-it, Move-it’ program was found to be proficient on the New England Common Assessment Program NECAP exam testing for reading. On the other hand, 51% of the students who took part in the study were found to be proficient on the mathematics exam (Garnett 2013).

Secondary

The results of the study completed by Kao, Westfall, Parks, Pontifex & Hillman (2016) show that increased levels of muscular and aerobic fitness were related to a higher performance in task conditions that put an increased demand on the students’ working memory (Kao et. Al., 2017). The findings from the study also recommend that muscular and aerobic fitness have similarities as well as different associations with academic achievement and working memory (Kao et. Al., 2017). Fox, Barr-Anderson, Neumark-Sztainer & Wall (2010) concluded that their study indicated that a positive association between academic achievement and physical activity involvement exists among high school students.

A notable relationship between academic achievement and vigorous activity was found in Podulka-Coe, Pivarnik, Womack, Reeves & Malina’s 2006 study. In the first semester of their study, when the participants took part in any quantity of vigorous activity, they were shown to
have performed better academically when compared to the students who did not do any vigorous activity. During the second semester, only the participants who met or exceeded the amount of vigorous activity in the 2010 Healthy People recommendations, performed at a higher level academically when compared to students who did a small amount or no vigorous activity (Podulka-Coe, et. Al., 2006). After controlling for demographic variables, such as grade, sex, IQ, socioeconomic status and age hierarchical analysis, Kao, Westfall, Parks, Pontifex & Hillman (2016) found that children taking part in aerobic fitness activities had an increase in correct responses. The students were found to have earned higher math scores and showed better performance on algebraic functions within the academic tests utilized within the study (Kao, et. Al., 2016).

**Males vs. Females**

From the research completed by So in 2012, it was concluded that in comparison to boys who did not take part in vigorous physical activity, the ones who did so two to four times a week were more likely to report either average or above average academic performance. In comparison to boys who did not take part in moderate physical activity, the ones who did one or more than five times a week were more likely to report either average or above average academic performance (So, 2012). Boys who took part in strengthening exercises five or more times a week were less likely to report below average academic performance (So, 2012). Vigorous PA done less than four times a week had a positive correlation with academic performance in boys (So, 2012).

In comparison to girls who did not take part in vigorous physical activity, the ones who did so five or more times a week were more likely to report either average or above average academic performance (So, 2012). In comparison to girls who did not take part in moderate
physical activity, the ones who did two to four times a week were more likely to report either average or above average academic performance (So, 2012). Girls who took part in strengthening exercises five or more times a week were less likely to report below average academic performance (So, 2012). Garnett, Becker, Vierling, Gleason, DiCenzo, & Mongeon, (2013) found that girls who participated in the before and after school physical activity program within their study, reported higher levels of commitment to school when compared to the boys.

The findings from the research done in 2012 by So demonstrates that moderate physical activity has a positive correlation with academic performance in both adolescent Korean boys and girls. The results show that physically active boys and girls are more likely to perform well academically in school (So, 2012). The results of this study show that physical activity may increase memory and brain function (So, 2012). Moderate physical activity does have a positive effect on both boys’ and girls’ academic performance (So, 2012). Ma, Le Mare, & Gurd, (2014) found that there were no significant differences between boys and girls off-task behaviors on days where they did no activity.

What types of physical activity have the most positive impact on academic performance and how much:

a. **Physical education?**

b. **Recess and classroom based physical activity?**

c. **Extracurricular physical activity and sports?**

**Physical Education**

Podulka-Coe, Pivarnik, Womack, Reeves, & Malina (2006) determined using SOFIT, that having an average of 19 of the 55-minute-long class involved moderate to vigorous physical
activity, which most likely would not be a sufficient amount of stimulation to influence a student’s academic achievement. Scores of standardized tests were examined within the study and The Terra Nova test was given during April of the second semester (Podulka-Coe, et. Al., 2006). The results were not found to be highly significant, but the standardized test scores were found to be just about 10% higher for students who were taking physical education class physical education during their first semester when compared to the students in physical education during the second semester (Podulka-Coe, et. Al., 2006). The combined academic achievement scores were not affected by the time of enrolling in a physical education class (Podulka-Coe, et. Al., 2006). Students who were taking a physical education class during the study were not shown to have performed at an increased or decreased level of academic performance when compared to the students who spent the 55 minutes in a classroom (Podulka-Coe, et. Al., 2006).

**Recess and Classroom Based Physical Activity**

The results of Garnett, Becker, Vierling, Gleason, DiCenzo & Mongeon (2013) study implementing the community based initiative that was utilized as a pilot study was proven to have had a positive effect on behavioral and academic outcomes. This initiative was associated with students engaging in the before-school physical activity program which provided incentive for the students (Garnett, et. Al., 2013). The miles that were walked by the students were shown to be a significant positive influence with their NECEP mathematics scores (Garnett, et. Al., 2013). According to the bivariate model, it was shown that a 1-mile increase in miles that were either run or walked, directly related with a slight but significant increase in math scores, which was maintained after controlling for gender (Garnett, et. Al., 2013).

The study completed by Torbeyns, de Geus, Bailey, Decroix, Cutsem, De Pauw, & Meeusen (2017) found that using bike desks did not interfere with an adolescent’s academic
performance or attention in class. They concluded that it could be used as an effective way to reduce sedentary time while in class to improve their physical health (Torbeyns, et. Al., 2017). Having bikes in the classroom led to an increase in their aerobic fitness and influenced positive changes in terms of BMI (Torbeyns, et. Al., 2017).

The most vital finding in the research finished by Ma, Le Mare, & Gurd (2015) was that four minutes of high-intensity interval activity improves selective attention in elementary school children (Ma, et. Al., 2015). The results conclude that FUNtervals can help to boost one’s performance on a selective attention test. This may also reveal that FUNtervals can improve the learning environment in-class, since they are easy to execute (Ma, et. Al., 2015). Performance of FUNtervals, a quick HIIT workout, in second and fourth grade classrooms results in a decrease in off-task behavior (Ma, et. Al., 2014). This effect was most prominent in the students who demonstrated the most off-task behaviors on non-activity days (Ma, et. Al., 2014).

**Extracurricular Physical Activity and Sports**

Podulka-Coe, Pivarnik, Womack, Reeves & Malina (2006) found that students who took part in vigorous physical activity to a point where they met or surpassed the requirement for the healthy people 2010 guidelines achieved scores that ranked higher than other students in both the first or the second semesters. Kantomaa, Stamatakis, Kankaanpää, Kaakinen, Rodriguez, Taanila, Ahonen, Järvelin & Tammelina (2013) concluded that children taking part in physical activity was ultimately related to them obtaining a higher grade-point average. It was also concluded that a child experiencing compromised motor function during their childhood was shown to have a negative indirect effect on an adolescent’s academic achievement via physical activity (Kantomaa, et. Al., 2013). The findings of the research by Kao, Westfall, Parks, Pontifex, Hillman (2016) suggested that there are differing results when it comes to the
relationship between muscular and aerobic physical fitness with one’s academic achievement or working memory.

Podulka-Coe, Pivarnik, Womack, Reeves & Malina (2006) reported that participation in sports may provide a sufficient level of intensity to obtain the necessary threshold to see desirable results of physical activity on academic achievement and fitness. The results of this study indicate that high school boys and girls and middle school boys sports team participation had a relationship with a higher GPA (Hashim, et. Al., 2012).

Fox, Barr-Anderson, Neumark-Sztainer & Wall (2010) concluded that sports team participation and physical activity were each independently associated with a higher GPA for high school girls. Only participation on a sports team was independently associated with the participant having a higher GPA for high school boys. The positive association between grade point average and physical activity was unable to be separated from the relationship that exists with grade point average and participation on a sports team (Fox, et. Al., 2010). Hashim, Golok & Rosmatunisah (2012) found that when it came to middle school students, both males and females, the relationship between taking part in moderate to vigorous physical activity for an increased amount of time and having a higher GPA could not be separated from the positive association that sports team participation had with academic outcomes. A notable strength of the study was that the data that was composed relating to participation in sports teams and physical activity allowed for divided inspection of the contribution that each variable had in relation to academic outcomes (Hashim, et. Al., 2012).
Chapter 5: Conclusions and Future Recommendations

Based on the results of this study it is evident that children taking part in physical activity does in fact justify taking time away from academics. The benefits of physical activity expand across many different areas of a child’s life. Overall, the positive things that come with being physically active outweigh the negatives, due to the effects on a child’s physical health, cognition as well as behavior. The results from the studies show that physical activity may increase memory and brain function in both male and female children and that moderate physical activity does have a positive effect on the academic performance of both boys and girls.

Evidence indicates that physical activity boosts focus as well as cognitive functions in children while helping to increase attention within the classroom. Habituated exercise has been shown to assist children in combating the negative side effects that come with stress, anxiety or depression. It was concluded that muscular fitness is an important factor to one’s cognitive health during preadolescent years, leading to an increase in the students’ focus on academics, enjoyment, and participation in physical activity, being more alert and mindful of healthy choices. It was found that high levels of physical activity promote self-determination and academic achievement and were found to be positively related with habituated exercise behavior.

When it comes to the negative and neutral effects that were addressed pertaining to physical activity in relation to a child’s academic performance, the findings were very weak and insignificant. Within the results it was concluded that physical activity may have the ability to influence a child’s academic performance. Within the study where students were either enrolled in a physical education course or not (Podulka-Coe, et. Al., 2006), it was concluded that being active 19 minutes of the 55-minute class is not enough activity to have an effect. At the same
time though, the decreased time that was spent in the classroom, compared to classmates who spent those extra 55 minutes learning, do not translate into lower academic performance either.

For elementary aged students, it can be concluded that performing physical activity before, during or after school in short bouts is beneficial for both health and academic performance. According to the research, it was concluded that physical activity had a positive effect on behavioral and academic outcomes. Preforming a very quick bout of a high intensity interval training (HIIT) exercise with second and fourth grade students was concluded to have decreased their off-task behavior. The effect of the HIIT workout on their behavior was most prominent in the students who demonstrated the most off-task behaviors on non-activity days. The FUNtervals only takes about four minutes out of the school day and helps to improve the childrens’ focus and attention. This can be done right in the classroom, which would not even take the students away from the classroom environment. When it comes to the ‘Move It Move It’ intervention where students walked miles during a before and after school program, the students who walked more miles were found to be more proficient on standardized tests. A study found that school based health programs that target lifestyle behaviors have a more powerful effect than the ones who focus on a single behavior.

When it comes to secondary students, it is recommended that physical activity takes place by participating in activities of their own choice or by participating in sports. It was concluded that a positive association between academic achievement and physical activity involvement exists among high school students. Research participants who took part in any quantity of vigorous activity were shown to have performed better academically when compared to the students who did not do any vigorous activity. Participants who met or exceeded the amount of vigorous activity claimed by the 2010 Healthy People recommendations, performed at a higher
level academically when compared to students who did a small amount or no vigorous activity. The results of the studies show that middle school and high school boys and girls who are involved in a sports team had a relationship with a higher GPA. Performing an increased amount of moderate to vigorous physical activity was related to having a higher GPA in boys and girls in middle school as well as boys in high school. From this, we can conclude that secondary age males and females who perform vigorous physical activity two to four times a week, including resistance exercise, were more likely to report either average or above average academic performance when compared to students who did not perform physical activity. Secondary age males and females who took part in moderate physical activity one to five or more times per week, including resistance exercise were more likely to report either average or above average academic performance.

**Future Research**

In the future, more longitudinal studies need to be completed on the effect of physical activity on K-12 student’s academic performance over an extended period of time. This would help to really find out what duration of activity, per week, would harvest the most positive outcome on a student’s academics as well as health. The research that was found pertaining to the negative or neutral effects that physical activity has on academics was not very comprehensive. There needs to be more research completed in that area. Another possible recommendation for the future is to complete more longitudinal studies which include more of the in school in class physical activity or physical education in comparison to sport participation and extracurricular physical activity. This could set up a study to see if in school interventions or out of school interventions work better between the elementary and secondary aged students.
References


7. www.google.com (for definition of Physical Education)


15. Torbeyns, T., de Geus, B., Bailey, S., Decroix, L., Cutsem, J.V., De Pauw, K., &


### Appendix A

#### Synthesis Article Grid

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Source</th>
<th>Purpose</th>
<th>Methods &amp; Procedures</th>
<th>Data Analysis</th>
<th>Findings/Results</th>
<th>Conclusions/ Discussion/ Recommendations</th>
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<tbody>
<tr>
<td>#1 “Bike desks in the classroom: energy expenditure, physical health, cognitive performance, brain functioning, and academic performance”</td>
<td>Tine Torbeyns, Bas de Geus, Stephen Bailey, Lieselot Decroix, Jeroen Van Cutsem, Kevin De Pauw, and Romain Meeusen</td>
<td>Human Kinetics Journal of Physical Activity and Health</td>
<td>To investigate the influence of having bike desks within a classroom on adolescents’ physical health, energy expenditure, academic performance, and brain functioning.</td>
<td>44 adolescents over a 5-month period, using a bike desk for 4 hours of class per week. Their energy expenditure was measured for 6 consecutive days. Randomly assigned to either an intervention group (IG) or control group (CG). All participants had aerobic fitness, academic performance, brain functioning, anthropometric parameters, and cognitive performance all measured before (shown by T0) and after (shown by T1) the intervention.</td>
<td>Statistical analyses conducted using IBM SPSS statistics. ANOVA used for repeated measures to find out differences. Kolmogorov-Smirnov test used to test normality of data. Data presented as mean ± or – SD, statistical significance set at P&lt;.05.</td>
<td>The energy expenditure that was found in the Intervention group was extremely higher during the hours that the student participants were in class and utilized the bike desks in comparison to normal class hours.</td>
<td>The control group was found to have had quite a bit higher of a BMI at T1 when compared to T0, but this was not found to be a significant difference for the intervention group. The aerobic fitness level of the intervention group at T1 versus T0 was significantly better. There were no standout effects on cognitive performance, academic performance, and brain function. Using the bike desks did not interfere with the adolescent’s academic performance or attention in class. They concluded that it could be used as an effective way to reduce sedentary time while in class to improve their physical health. Having bikes in the classroom led to an increase in their aerobic fitness and influenced positive changes in terms of BMI. Future Research: Using observations instead of questionnaires to access results.</td>
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### Article #1 Reference Citation:

### Article #1 In-text Citation:
(Torbeyns, et. Al., 2017)

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<th>Analysis</th>
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<th>Conclusions/ Discussion/ Recommendations</th>
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</thead>
<tbody>
<tr>
<td>#2 “Associati on between physical activity and academic performan ce in Korean adolescent students”</td>
<td>Wi-Young So</td>
<td>BMC Public Health</td>
<td>To consider the effects that many types of physical activity done at several different frequencies have on adolescent students in Korea.</td>
<td>75,066 adolescent students: 35,454 females and 39,612 males, between 7th to 12th grades. Took part in the Korea Youth Risk Behavior Web-based Survey (KYRBWS-V) project, completed in 2009. Using data found by the survey, potential relations between PA and academic performance were investigated in this current study.</td>
<td>SPSS for statistical analysis. Multivariate logistic regression analysis incorporating adjustment for covariate variables including BMI, parent’s education level, age, the and the income status of the family.</td>
<td>In comparison to boys who did not take part in vigorous physical activity, the ones who did 2 to 4 to 4 times a week were more likely to report either average or above average academic performance. In comparison to boys who did not take part in moderate physical activity, the ones who did 1 to &gt; or = 5 times a week were more likely to report either average or above average academic performance. Vigorous PA done &lt;4 times a week had a positive correlation with academic performance in boys. Boys who took part in strengthening exercises &gt; or = 5 times a week had were less likely to report when boys take part in vigorous PA more than 5 times a week and both boys and girls take part in strengthening exercise more over 5 times a week, it was shown to have a negative correlation with their academic achievement. Shows that physically active boys and girls are</td>
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below average academic performance.

In comparison to girls who did not take part in **vigorous physical activity**, the ones who did so 5 or more times a week were more likely to report either average or above average academic performance.

In comparison to girls who did not take part in **moderate physical activity**, the ones who did 2 to 4 times a week were more likely to report either average or above average academic performance.

Girls who took part in strengthening exercises $\geq 5$ times a week had were less likely to report below average academic performance.

more likely to perform well academically in school.

The results of this study show that PA may increase memory and brain function.

Moderate physical activity does have a positive effect on both boys and girl’s academic performance.

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<td>Title</td>
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<tr>
<td>#3 “Four minutes of in-class high-intensity interval activity improves selective attention in 9- to 11-year olds”</td>
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activity in schools is on the decline. They aimed to find physical activity that is time-efficient that would demonstrate their positive impact on one’s academic achievement to show the need for PA within a curriculum.

test which was for attention and the activities FUNterval included and the children’s baseline off-task behavior was observed.

In the second and third weeks, the students took part in the test of attention after finishing a no-activity break or a FUNterval break. The order that the breaks were put into was switched up and not the same week to week.

Off-Task behavior and selective attention
While using simple linear regression tests, motor off-task behaviors as well as baseline passive behaviors were not found to predict the adjustments in the d2 test outcomes. Some examples of this is the difference that was found between the no activity d2 test performance and FUNterval.

This may also reveal that FUNtervals can improve the learning environment in-class, since they are easy to execute.

Article #3 Citation:

Article #3 In-text Citation:
(Ma, et. Al., 2015)

<table>
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<tr>
<th>Title</th>
<th>Author</th>
<th>Source</th>
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<th>Data Analysis</th>
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<tbody>
<tr>
<td>#4 “Classroom-based high-intensity”</td>
<td>Jasmin K. Ma, Lucy Le Mare, and</td>
<td>Applied Physiology, Nutrition, and</td>
<td>The purpose of this study was to investigate the effects that an A 4th grade class (24 students) and 2nd grade class (20 students) were opened up to either</td>
<td>Paired samples t-test- to compare mean-off task behavior between</td>
<td>There was no significant correlation that was detected between the decrease in off-task behavior and the</td>
<td>Performance of FUNtervals, a quick HIIT workout, in 2nd and 4th grade classrooms results in</td>
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<td>Interval activity improves off-task behaviour in primary school students</td>
<td>Brendon J. Gurd</td>
<td>Metabolism</td>
<td>acute bout of quick HIIT exercise on off-task behaviours in young grade school students.</td>
<td>an active break consisted of “FUNtervals” HIIT on alternating days for 3 weeks or a no-activity break. No activity days included a 10-minute inactive break while “FUNterval” had a 4 minute “FUNterval” with a 10 minute break from normal class activities.</td>
<td>no activity days and FUNtervals.</td>
<td>participation scores for FUNterval activity as a result of taking part in FUNtervals. There was a significant correlation was found to exist between the decreases in motor off-task behavior and participation scores for FUNterval activity. For the second grade students, there was no denoting relationship that was observed between a child’s decline in off-task behavior observed and their participation scores following FUNtervls. There were no significant differences between boys and girls off-task behaviours on days with no activity.</td>
<td>a decrease in their off-task behavior. This effect was most prominent in the students demonstrated the most off-task behaviors on non-activity days. The results show that the FUNtervals workout was executed into elementary classrooms while also displaying the effectiveness of a very quick physical activity break in order to assist in decreasing off-task classroom behavior.</td>
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Article #4 Citation:

Article #4 In-text Citation:
(Ma, et. Al., 2014)
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<tr>
<td>#5 “The combined impact of diet, physical activity, sleep and screen time on academic achievement: a prospective study of elementary school students in Nova Scotia, Canada”</td>
<td>Erin L. Faught, John P. Ekwaru, Douglas Gleddie, Kate E. Store, Mark Asbridge and Paul J. Veugelers</td>
<td>International Journal of Behavioral Nutrition and Physical Activity</td>
<td>To find out whether or not the combined effect of diet, physical activity, sleep and screen time will have a higher impact on academic achievement than any other behavior alone, or weight status.</td>
<td><strong>Nova Scotia</strong> 4253 5th grade students and their parents were surveyed on what the child’s diet was like, sleep, screen time and physical activity. Heights and weight measured AA was measured using exams within the providence in math, writing and reading and was graded based on ‘meeting’ or ‘not meeting’ expectations of the standardized criteria. Yes/No was utilized to measure whether recommendations were met when it came to lifestyle.</td>
<td>Standardized tests Self and parental proxy reports Mixed effects regression models</td>
<td>It was found that when a participant was to meet the dietary recommendations, this was ultimately associated with heightened likelihood that they would meet the academic expectations that exists for each of math, reading and writing. One interesting finding was that when a child meets the recommendations either sleep or for screen time, this was correlated with them meeting expectations for writing. When it came to the three subjects (writing, math and reading), an individual’s ability to meet added lifestyle behavior recommendations had a correlation with an increased the probability of them meeting the</td>
<td>Lifestyle behaviors (not body weight) are strongly associated with student academic performance. Promoting compliance with healthy lifestyle recommendations can boost both educational and health outcomes in children. School based health programs that target many lifestyle behaviors have a more powerful effect than the ones who focus on a single behavior. The findings from this study also indicated that the combined effects of meeting multiple lifestyle behavior recommendations had a stronger impact on academic achievement than the individual effects of lifestyle behaviors, particularly for reading and writing.</td>
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behaviors and self-and parental proxy. expectations which were set for their academics. If a child met with seven to nine of the lifestyle behaviors recommendation’s, they were found to have higher than three-times the odds of meeting the anticipated results for reading expectations when they were compared the scores of the participants who met zero to three of the recommendations.

**Article #5 Citation:**

**Article #5 In-text Citation:**
(Faught, et. Al., 2017)

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<th>Findings/Results</th>
<th>Conclusions/ Discussion/ Recommendations</th>
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<tr>
<td>#6 “Implementation of a school-based state policy to increase”</td>
<td>Kelly R. Evenson, PhD, Kymm Ballard, MA, Ginny Lee, BS, Alice</td>
<td>Journal of School Health</td>
<td>The purpose of this study is to describe how districts across North Carolina worked to meet the</td>
<td>Summer of 2007, online survey conducted. 95.5% response rate (106/111 school districts).</td>
<td>Online survey - Answers were coded and grouped into themes.</td>
<td>Many positive effects were reported on the policy within elementary and middle schools. PA requirement was typically fulfilled through recess,</td>
<td>Implementation of the policy produced many positive results for the students and the staff. Addressing the challenges to implementation that were common across the</td>
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**PHYSICAL ACTIVITY AND ACADEMICS FOR CHILDREN**

<table>
<thead>
<tr>
<th>physical activity”</th>
<th>Ammerman, DrPH, RD</th>
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<tr>
<td>physical activity portion of an Healthy Active Children Policy and looks into the implementation of the policy as well as any successes or challenges.</td>
<td>The North Carolina School System consists of 2484 schools, between 115 districts during the 2007-2008 school year, of these four locations which combine city and county school district responses on the survey, 111 school districts total. Elementary and middle school aged students participated in the study. Participants asked to describe any successes as well as challenges in the implementation of having 30 minutes of physical activity during the school day.</td>
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<td>intramural sports or energizers done in the classroom.</td>
<td>Benefits:</td>
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<td></td>
<td>- Increased student focus on studies</td>
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<td>- Awareness of Healthy habits</td>
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<td>- Teacher participation</td>
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<td>- Lack of time during the school day</td>
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<td>- Concerns that arose about academics</td>
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**Article #6 Citation:**
#7 “Physical activity and obesity mediate the association between childhood motor function and adolescents’ academic achievement”

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<th>Data Analysis</th>
<th>Findings/Results</th>
<th>Conclusions/ Discussion/ Recommendations</th>
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<tbody>
<tr>
<td>PANA S (Proceedings of the National Academy of Sciences of the USA)</td>
<td>Marko T. Kantomaa, Emmanuel Stamatakis, Anna Kankaanpää, Marika Kaakinen, Alina Rodriguezb, Anja Taanilae, Timo Ahonen, Marjo-Riitta Järvelin and Tuija Tammelina</td>
<td>The perspective study researched if motor function in childhood determines their academic achievement through obesity, fitness and physical activity down the road.</td>
<td>8061 Children who were involved from the Northern Finland Birth Cohort from 1986. The Northern Finland Birth Cohort data about parent-reported motor function at 8 years old and self-reported physical activity, predicted ones cardiorespiratory fitness (including cycle ergometer test), academic achievement (grades) at 16 years old, obesity (body weight and height).</td>
<td>The Structural equation models included standardized (β), as well as unstandardized (B) coefficients were utilized to experiment if and to what extent or if not cardiorespiratory fitness, obesity by the age of sixteen and physical activity fitness, had a neutral association between an adolescent’s academic achievement as well as their childhood motor function.</td>
<td>The children taking part in physical activity was related to them having a higher grade-point average. It was found that obesity had a relationship with a student having a lower grade-point average during their adolescence. Compromised motor function in one’s childhood was shown to have a negative indirect effect on an adolescent’s academic achievement via physical activity.</td>
<td>The results suggest that obesity and physical activity may mediate the association between adolescents’ academic achievement and childhood motor function.</td>
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**Article #7 Citation:**

### Article #7 In-text Citation:
(Kantomaa, et. Al., 2013)

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<tr>
<td>&quot;Academic performance and participation in physical activity by secondary school adolescent’s&quot;</td>
<td>Amanda J. Daley and Jason Ryan</td>
<td>Perceptual and Motor Skills</td>
<td>The purpose of this study was to research the relationship that exists between an adolescent’s participation in physical activity and academic performance.</td>
<td>The study consisted of 232 participants, made up of 232 boys and girls. There were all between the ages of 13 and 16 years old and attended a mixed catholic comprehensive school that was located in southwest England. Three of the classes were randomly selected from grades 8 (60 participants) ,9 (67 participants) ,10 (55 participants) and 11 (50 participants). The number of boys versus girls was pretty close to being even. The results that were compiled include scores of the</td>
<td>Before data was collected, Daley and Ryan completed a pilot study which included an 8th grade class to make sure the process of the study was smooth. Data collection for physical activity and academic performance was not recorded at the same time in the year, therefore a relationship cannot be drawn. Seeing as how grades were drawn from the end of the year examinations which tests for the core subjects, this typically causes an increase in study</td>
<td>The correlations that were made between participation in physical activity (frequency and minutes) and academic performance did not support the hypothesis that was made for the study. A weak negative correlation between the number of minutes spent taking part in exercise and sport with the English scores who were ages 13, 14 and 16. There was a similar relationship with 16-year old’s and science scores.</td>
<td>There was not a significant association between academic ability with physical activity therefore no assumptions can be made. The data may show that exercise and sport may have a negative effect on one’s academic attainment, but the samples were relatively small so there was not an extreme focus on negative correlations. Students who attend the school need to get permission from the priest. Therefore, the grades of the students tended to weigh more on the higher side which very well could have restricted the variability that exists within the scores of performances.</td>
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<td>students grades 8 through 11, from the common core classes including math, English and science.</td>
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<td>Grades were listed as A=5, B=4, C=3, D=2, E=1, collected at the end of the year.</td>
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<td>Students took part in a modified version of the Physical Activity Participation Questionnaire where they were asked to list their typical amount of days they participate in physical activity per week as well as the amount of time they typically do so. This included all types of sports or physical activities that they take part in during a normal week during or even after school.</td>
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<td>time and a decrease in physical activity for the time being.</td>
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**Article #8 Citation:**

**Article #8 In-text Citation:**
(Daley & Ryan, 2000)

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<tbody>
<tr>
<td>#9 “A mixed-methods evaluation of the move it move it! before-school incentive-based physical activity program”</td>
<td>Bernice R Garnett, Kelly Becker, Danielle Vierling, Cara Gleason, Danielle DiCenzo and Louise Mongeon</td>
<td>Health Education Journal</td>
<td>To determine the impact of a program that was created to find how a before and after school program incorporating physical activity, effected the students grades in academics and behavior. The main goal of this initiative was to create a community, assist in getting students ready to learn and</td>
<td>Self-reported surveys were given to all students who had consent. All parents/guardians were given a flyer with information and they utilized an opt-out approach. Participants consisted of students between 3&lt;sup&gt;rd&lt;/sup&gt; and 5&lt;sup&gt;th&lt;/sup&gt; grades at the Integrated Arts Academy (IAA) in Vermont. The pool was made up of 129 children. Interviews were done with school officials in a semi-structured manner</td>
<td>Mixed methods pilot feasibility study. Descriptive statistics for all of the variables were calculated. Analyses were completed to find correlations and bivariate associations. – These used to find the relationships between the miles that were either walked or ran. Chi-square tests were involved to find any associations that existed Analysis of variance was</td>
<td>During 2013-2014, 41 percent of the in the study were found to be proficient when it came to the NECAP exam testing for reading. On the other hand, 51% of the students who took part in the study were found to be proficient on the mathematics exam. The average amount of miles that were walked by the students was 20 throughout the program. The boys were found to have walked more averaging 28.5 miles and the girls averaging at 13.2 miles. The boys who were in this study reported higher difficulty completing school related tasks</td>
<td>The results of this community based initiative that was utilized as a pilot study was proven to have had a positive effect on behavioral and academic outcomes. This was associated with students engaging in the before-school physical activity program which provided incentive for the students. Future replication of the studies is required in order to confirm that the program is effective in various communities. It is important to realize that the incentives and rewards are the most notable to a student population.</td>
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</table>
Physical activity and academics for children

| boost fitness levels. | Burlington, Vermont. | with the team who created the program (5 individuals). Qualitative interviews were completed to follow up with the quantitative survey. | utilized to look into the relationship between the mean number of miles walked or ran and bullying behaviors. Linear Regression analyses were conducted to find the association between the academic achievement and the move it Move it miles that were ran or walked to predict the scores of the New England Common Assessment Program mathematics testing scores. The qualitative data was then transcribed and codes were given to the portions of the qualitative interviews which (involving their self-regulation and self-efficacy). The boys reported more engagement in bullying like behaviors when compared to the girls. Girls reported having higher levels or commitment to school when compared to the boys. According to the results of the multivariable linear regression models which show the NECAP mathematics scores with the commitment to school, the miles that were walked by the students were shown to be a significant positive influence with their NACEP mathematics scores. According to the bivariate model, it was shown that a 1-mile increase in miles that were either ran or |
Hierarchical codes were then created in order to organize the major descriptive codes. The frequency of the codes and interactions were compared between the interviews that took place in order to identify any major themes that became apparent. This was utilized to determine whether or not the themes aligned with pre-determined hypotheses.

Data was analyzed using Dedoose which is an online software that specialized in mixed-methods.

From the qualitative interviews, completed with the school staff; their responses were broken down and concluded into four main themes that signify the impact that the program had on the participants, these included; the schools climate and the community within the building, academic learning, the student’s behavior and the importance of the incentives that were shown in initiating and completing the program with involvement of students.

**Article #9 Citation:**

...

**Article #9 In-text Citation:**
(Garnett, et. al., 2013)

| #10 | “Effects of physical education and activity levels on academic achievement in children.” | Dawn Podulka Coe, James M. Pivarnik, Christopher J. Womack, Mathew J. Reeves, Robert M. Malina | Medicine & Science in Sports & Exercise | The purpose of this study was to determine what the effect of physical education classes has on their academic achievement and if there was a difference taking part when comparing the fall to the spring semester. | 216 sixth grade students at a school in Michigan. The average income of the school is higher than that of Michigan. A packet with information and consent forms was sent home with students and it was all based off of volunteering. Students were assigned to a team which had a teacher from each core course. They were randomly assigned for a semester- one group was assigned to take physical education during the autumn while the other took the course during the spring. | A comparison of age, anthropometric and demographic characteristics between semester groups utilizing paired t-tests. The use of the Sharpio-Wilk test results displayed that the outcome variables, including both grades and the Terra Nova Scores were not normally distributed. The differences in academic achievement were assessed using the Kruskall-Wallis analysis. | The only significant difference between the groups was their BMI. No pre-test data was available so the only thing they had to base it off of was the midpoint (end of the first semester) and the posttest which was done at the end of the second semester. The combined academic achievement scores were not affected by the time of enrolling in a physical education class. The Terra Nova Standardized test scores were not shown to have any affect from students being enrolled in physical activity. First Semester scores = 55.3 +/- 27.5 and second semester scores = 57.5 +/- 29.0. | A student’s enrollment in a physical education course did not affect their academic grades or performance in their core classes. It was determined using SOFIT, that having an average of 19 of the 55-minute-long class involved moderate to vigorous physical activity, which most likely would not be a sufficient amount of stimulation to influence a student’s academic achievement. Students who were enrolled in a physical education class during the study were not shown to have performed better in terms of academics in comparison to the students who had those 55 minutes...
first semester and the other group was assigned to take it the second.

During the semester the student didn’t take the PE class, they were enrolled in an exploratory class such as involving computers or art.

**Anthropometry:** Height measured to nearest millimeter with a field anthropometer. Weight measured to the closest .1 kilogram and BMI was calculated.

**Physical Activity Recall:** Habitual physical activity estimated using the 3-d physical activity recall that asks the child about their activity for the past 3 consecutive days.

Therefore, Coe, Pivarnik, Womack and Malina determined if there were differences in academic achievement based off of the semester students enrolled in physical education and their level of physical activity.

semester scores = 60.6 + - 20.3.

Students who took part in vigorous physical activity to a point where they met or surpassed the requirement for the healthy people 2010 guidelines achieved scores that ranked higher than other students in both the first or the second semesters.

No stand out differences were discovered in academic achievement or Terra Nova scores due to physical activity during both semesters.

in a classroom. The decreased time spent in the classroom though, did not translate into lower academic performance either.

Rises in academic performance are related with vigorous activity, but not moderate physical activity in the present analyses.

Grades compared with out-of-school, self-reported levels of physical activity.

The performed amount of moderate physical by the sixth-grade students did not have an effect on academic achievement.

A notable relationship was found to exist between academic achievement and vigorous activity. In the first semester, when the participants took part in any quantity of vigorous activity, they were shown to have performed better.
MET values for each activity within the questionnaire were assigned depending on the intensity of the activity. From this the 30-minute blocks of activity were changed over to ordinal data, such as a score 1-3 (no activity, some activity or meets the healthy people guidelines 2010, respectively).

**Academic Achievement:**
Based on the students grades in core classes. A=5, B=4, C=3, D=2, F=1. First semester grades reported in both November and January, second semester grades reported in April and June.

Academically when compared to the students who did not do any vigorous activity. During the second semester, only the participants who met or exceeded amount of vigorous activity in the 2010 Healthy People recommendations, executed at a higher level academically when compared to students who did a small amount or no vigorous activity.

Scores of standardized tests were examined within the study and The Terra Nova test was given during April of the second semester. The results were not found to be highly significant, but the standardized test scores were found to be just about 10% higher for students who were taking physical education class physical education during their first semester when compared to the students in physical education during the second semester.
SOFIT (System for Observing Fitness Instruction Time): Where PE classes are directly observed, student activity levels are recorded and qualitative evaluations were performed.

| Article #10 In-text Citation: (Podulka-Coe, et. Al., 2006) |

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<td>A minimum activity intensity may be necessary to elicit changes in the child that could lead to an increase in academic achievement.</td>
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<td>Participation in sports may provide a sufficient level of intensity to obtain the necessary threshold to see desirable results of physical activity on academic achievement and fitness.</td>
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<td>There is a potential influence that socioeconomic status may have on the association between academic achievement and vigorous physical activity and therefore cannot be ruled out.</td>
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<tr>
<td><strong>#11</strong></td>
<td>“Muscular and aerobic fitness, working memory, and academic achievement in children”</td>
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<tr>
<td><strong>Authors:</strong></td>
<td>Shih-Chun Kao, Westfall, Daniel R. Parks, Andrew C. Pontifex, Matthew B. Hillman, Charles H Medici &amp; Science in Sports &amp; Exercise</td>
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<td><strong>Participants:</strong></td>
<td>To investigate the relationship that exists between both muscular and aerobic fitness with academic achievement as well as working memory in preadolescent children.</td>
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<td><strong>Data:</strong></td>
<td>Participants: 135 preadolescent children were contacted between November of 2013 and September of 2014. 93 children participated in the study after they were found to be free of attention deficit hyperactivity disorder or neurological disease, were capable of performing exercise according to a pre-exercise screening and were not enrolled in an educational program that was individualized. Written consent was gained from each participant’s parent or legal guardian. This was approved by the University of Illinois at Urbana Institutional Review Board.</td>
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<td><strong>Analysis:</strong></td>
<td>Data was analyzed using SPSS. Bivariate correlations were completed to compare fitness indices, performance of the academic achievement test, demographic variables as well as n-back tasks performance measures across 1 and 2 back conditions. Linear hierarchical regression analyses were completed using aerobic or muscular fitness measures that were closely correlated with academic achievement or utilizing working memory. The measures of working memory after controlling the demographic variables, such as grade, sex, IQ, socioeconomic status and age hierarchical analysis found that the children taking part in aerobic fitness had an association with having an increase in correct responses on the 2-back condition and earned higher math scores, with better performance on algebraic functions. The children’s muscular fitness was found to have a relationship with an increase in accuracy of their responses and the 2-back condition was strictly stemmed from aerobic fitness. The findings of this research suggest that there are differing results when it comes to the relationship between muscular and aerobic physical fitness with one’s academic achievement or working memory. The research based mainly around the benefits of children taking part in aerobic fitness and the benefits and in conclusion they suggest that muscular fitness is an important factor to one’s cognitive health during their preadolescent years. The results show that increased levels of muscular and aerobic fitness were related with a higher performance in task conditions that put an increased demand on the students working memory. The results of the study recommend that muscular and aerobic fitness have...</td>
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All children were administered the Kaufman Brief Intelligence Test, second edition to conclude with an estimated IQ. They then went on to measure the children’s BMI, weight, height as well as muscular and aerobic fitness.

**Aerobic Fitness Assessment:**

VO2 Max was measured by using a computerized indirect calorimetry system. Polar heart rate monitors were worn by the students. The relative peak oxygen consumption was recorded based off their maximal effort (kilogram/minute). Maximum effort was based off of four confidence criteria assessed using an ANOVA 2x2 repeated measures analysis.

The final sample was 79 people, this excluded the individuals who had an IQ lower than 80, did not reach a VO2 Max Plateau or even two other confidence criteria during their aerobic fitness assessment, received less than a 50% in their responses to the n-back test.

A sensitivity analysis was completed on the 79 participants, to explain muscular or aerobic fitness while considering different demographic variables. These similarities as well as unlike associations with academic achievement and working memory.
<table>
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<th>Criteria which included: reaching a plateau in oxygen consumption, despite an increased workload, if their peak heart rate was at or above 185 and if the child rated their perceived exertion as at or above an 8.</th>
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</table>
| **Muscular fitness assessment:**
Consisted of a full body assessment involving the core, upper body and lower body. Participants were asked to complete as many reps as possible in 30 seconds with proper form at a comfortable weight. |
| **Cognitive Task:**
A n-back test presented the participants with a sequence of many variables include; sex, IQ, socioeconomic status, age and grade. |
different stimuli were instructed to answer as accurate and quick as possible using different prompts.

**Academic Achievement:**
The reading test included two categories that were 1. written conventions and 2. Reading comprehension. The math tests included three different types of questions; 1. functions and algebra 2. addition, subtraction, multiplication, and division 3. geometry and measure.

Children who were younger than 9.5 years, took the third to fourth grade edition of the tests and participants older than 9.5 years
took the forth to fifth grade edition. They were given 15 minutes to complete the test.

**Procedure:**
- Written consent was obtained by parents or legal guardians.
- Demographic questionnaire as well as K-BIT and academic achievement tests were completed.
- Socioeconomic status was calculated utilizing a trichotomous index which includes 1. Ones participation in the reduced or free lunch program 2. The number of parents who hold a full-time job 3. The highest level of education that was
received by the father and mother.

- All participants were given 72 practice runs of the n-back test for each condition. From there a 30-minute rest was given between the muscular fitness and the aerobic fitness assessment.
- The second day of testing included the children being seated in a sound attenuated chamber where they completed a computerized n-back test after 20 practice runs at each condition of the n-back test.

**Article #11 Citation:**

**Article #11 In-text Citation:**
(Kao, et. Al., 2016)

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<tr>
<td>#12</td>
<td>“Relationships Between Negative Affect and Academic Achievement Among Secondary School Students: The Mediating Effects of Habituated Exercise”</td>
<td>Hairul A. Hashim, Golok Freddy, and Ali Rosmatunisah</td>
<td>Journal of Physical Activity and Health</td>
<td>The purpose of this study was to examine the associations that exists between stress, depression, anxiety, exercise habit and academic achievement in adolescent’s.</td>
<td>Participants: 750 Secondary school students were involved in this study; 452 being boys and the other 258 being girls. All students were randomly selected, being from 3 different schools from an eastern state in Malaysia. All participants were 13 and 14 years old. 59.9 percent were 13 years and 20.1 percent were 14 years. When broken down into ethnicities, 0.4 percent were Chinese, 0.5% were Indian, 98.8% were Malaysian and 0.3% identified with other ethnic groups. Procedure: The student’s participation in the study was voluntary. Parents and guardians were given information and Structural Equation Modeling (SEM) was the form of data analysis for this study. The variables for the SEM models are either observed or latent variables. This analysis recognizes error in measurement of observed variables so the relationships of latent variables are estimated. Two models were tested. Model 1 showing that habituated exercise is positively related with habituated exercise behavior. The results that came of the structural equation modeling agreed with the hypothesized model. This indicated that high levels of self-determination were found to be positively related with habituated exercise behavior. It was found that exercise habit levels encouraged academic achievement and neutralized the negative effects of anxiety, stress and depression on a student’s academic performance. This model revealed that there was an insignificant difference between male and female participants.</td>
<td>The study concludes that taking part in habituated exercise supports academic performance and helps to lower the negative side effects that may come with anxiety, stress or depression and have on one’s academic performance. The results of this study indicate that high school boys and girls and middle school boys sports team participation had a relationship with a higher GPA. Performing an increased amount of moderate to vigorous physical activity was related to having a higher GPA boys and girls in middle school as well as boys in high school. For high school boys, it was found that only participation in sports teams, but not moderate to vigorous physical activity,</td>
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consent forms to be signed for the participants. Students who were given permission to participate were given a questionnaire which on average took about 10 minutes to finish.

**Instrumentations:**

**Exercise Habit Strength Questionnaire**
Measured with an 18-item questionnaire which asked about the student’s exercise habits. They had to answer about their feelings toward exercise and reflect, using a 6-point Likert scale. The questions branch into 4 different dimensions which include stimulus cue, patterned action, automaticity and negative consequences) which were set to represent their habits and behaviors.

related to a higher level of self-determination. Model 2 is similar except for the correlated terms including anxiety, depression and stress factors.

was correlated with a higher GPA.

When it came to middle school students, including both males and females, the relationship between taking part in moderate to vigorous physical activity for an increased amount of time and having a higher GPA could not be divided from the positive association that sports team participation had with academic outcomes.

A notable strength of the study was that the data that was composed relating to participation in sports teams and physical activity. This allowed for divided inspection of the contribution that each variable had in relation to academic outcomes.

The study supported the idea that, physical activity also has a positive impact on academic performance as an addition to the
### Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2)
The students exercise motivation was measured by the use of the BREQ-2. The statements reflect the reasons why an individual does or does not choose to take part in physical exercise. The participants were asked to determine on a 5-point Likert Scale, 0 being not true for them to 5 being very true for them. The statements were based off five different behavioral regulation from the self-determination theory. These include: intrinsic motivation, amotivation, introjected regulation, external regulation and identified regulation.

### Depression Anxiety Stress Scale-21 (DASS-21)

| Variety of health benefits it offers. Further research is needed to address the nature of the culture of academics when it comes to athletes versus non-athletes and how it ultimately contributes to a student’s academic success. |
This scale was used to measure the children’s stress level as well as anxiety and depression. On this questionnaire, participants had to answer to the extent that the statements applied to them during the past week. The responses were on a 4-point Likert Scale which ranged from 0 to three, not applying to them at all to applying to them all the time.

**Academic Performance:**
Academic performance was based on the results of a midyear exam where each student sat for tests in 8 subjects. Data that was received from the school was transferred to numerical data and averaged. A=1, B=2, C=3, D=4, E=5, F=6. In this study a lower GPA represents better academic performance. A negative
correlation between academic achievement and exercise habits signifies that a higher habit is correlated with better academic performance. On the other hand, a positive correlation shows that the higher the negative effect is (such as anxiety, stress or depression) the lower the academic performance is.

**Article #12 Citation:**

**Article #12 In-text Citation:**
(Hashim, et. Al., 2012)

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<tr>
<td>#13</td>
<td>Fox, Claudia K. Barr-Anderson, Daheia Neumark-Sztainer, Dianne Wall, Melanie</td>
<td>Journal of School Health</td>
<td>The purpose of the study was to examine the commonalitie s that exist between physical activity or participating, sports team</td>
<td>There were 4746 middle and high school students who data was collected from. The participants each attended a school in the Minneapolis or St. Paul metropolitan area of Minnesota. There were 31 schools involved in the data collection and there was</td>
<td>In model 1, 2 separate multiple regression analyses were utilized with grade point average being the outcome variable. The individual’s</td>
<td>Both sports team participation and physical activity were each independently associated with a higher GPA for high school girls. Only participation in a sports team was independently associated with the participant having a higher GPA for high school boys.</td>
<td>The findings of this study indicated that there is a positive association between academic achievement and physical activity involvement among high school students.</td>
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in middle school and high school students.” and the academic outcomes in middle and high schoolers. An equal participation of females (49.7 percent) and males (50.1 percent). The breakdown of middle school versus high school participation was 33.9 percent and 64.8 percent, respectively.

There was a diverse break in socioeconomic status, concluding with 13.7 percent with a high SES, 23.4 percent with an upper-middle SES, 26.5 percent with a middle SES, 18.9 percent with a lower-middle SES and 17.5 percent with a low SES.

The breakdown of ethnic and racial backgrounds included 19.0 percent African American, 19.2% Asian American, 28.5% white, 3.5% Native American and 3.9% other or mixed.

**Procedure:** participation in a sports team or moderate to vigorous physical activity hours were used as the predictor. Socioeconomic status, ethnicity and race were controlled.

T tests were done by the multiple regressions which aimed to find the differences in grade point average based on participation in a sports team and moderate to vigorous physical activity.

The positive association between grade point average and physical activity was unable to be separated from the relationship that exists with grade point average and participation in a sports team.
Data was collected during the 1998-1999 school year. Parental consent was required by 14 of the schools, while the other 17 approved with passive parental consent. Data was collected through the survey in Physical Education, Health and/or Science classes in two 50-minute periods or one 90-minute period.

**Instruments:**
The eating among teens survey (EAT) was utilized to access eating behaviors, weight-related issues, aspects of adolescent health. This was a 221-item survey.

**Measures:**
Questions on sociodemographic variables were asked including race, ethnicity and socioeconomic status. Participants were also asked about their sport team participation,
simply how many teams they had been involved in within the past 12 months. The students were then asked how many hours they spend participating in vigorous activity (quick heart beat), moderate (not extremely exhausting) and mild (low amount of effort). Grades were recorded by asking the students to mark the two main grades they receive the most; A, B, C, D, F. The letter grades were coded as follows; A=4.0, B=3.0, C=2.0, D=1.0 and the two grades marked by each individual was averaged into their grade point average.

**Article #13 Citation:**

**Article #13 In-text Citation:**
(Fox, et. Al., 2010)

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<td>#14</td>
<td>The aim of this research study was to discover the relationship between academic performance and objectively measured physical activity using a large group of children and adolescents. They also wanted to contribute to the debate about this topic. This study worked to access the long-term impact of sedentary behaviors as well as physical activity.</td>
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### Sample and Design:
The present analysis involved a total of 1778 adolescents and children who had total baseline data in terms of academic performance, maternal education level and objectively measured physical activity. Data was collected between September of 2011 and June 2012. The participants were between the ages of 6 and 18 from schools located in Madrid and Cadiz. These schools are ones who participated in the 3-year longitudinal UP & DOWN study.

Physical Activity: Physical activity was objectively measured by utilizing three different versions of the ActiGraph accelerometer, which are designed to detect vertical accelerations to different magnitudes.

Data from the accelerometer was downloaded and evaluated by using the ActiLife software.

The differences that exist between the sexes was compared using chi-squared tests for nominal and continuous variables and a one-way analysis of variance.

The relationship between academic performance and physical activity variables;

Physical activity was found to have an inverse relationship with all academic performance indicators.

The association of academic performance and objectively measured physical activity became insignificant within the physical activity quartiles.

There were very little distinctions in the academic performance of the lowest and the second quartile of physical activity when they were compared to that of the highest quartile.

The results of this study may indicate that adolescent’s and children who are more physically active, spend less time studying.

The researchers concluded that objectively measured physical activity may have the ability to influence academic performance in adolescent’s and children. The association that was found was very weak and very negative.

Intervention and longitudinal studies are needed to understand the participant changes over a period of time when it comes to academic performance and physical activity during an individual’s adolescence or childhood.
activity on health indicators.

Each participant was to wear the accelerometer on their low back for 7 days in a row. They were only to remove it during sleep or activities in the water. The relevant criteria to be included was recorded activity for at least 10 hours per day, 3 out of the 7 days.

**Academic Performance:**
Evaluated using school records at the completion of the school year. There were four main indicators that were utilized including: grade point average, language, mathematics and the average of the two core subjects. Letter grades were converted to numerical values, A=5, B=4, C=3, D=2, F=1

**Covariates:**
The participants sex, age and maternal education moderate physical activity, vigorous physical activity and moderate to vigorous physical activity were evaluated by use of a linear regression using three separate models.

The contrasts in academic performance were inspected age-specific and sex-specific quartiles of physical activity. This was completed at various intensities by testing the analysis of
| Level was recorded. Body mass index was calculated doing the individuals weight in kilograms divided by their height in meters squared. The student’s cardiorespiratory fitness was tested by taking part in the 20-meter shuttle run, where their score was the number of stages they finished. Their motor fitness was tested by completing 4, 10-meter shuttle runs. This test determined their levels agility, coordination and speed-of-movement. The fitness scores of the participants were calculated by finding the mean of the two standardized test scores. Covariance for the three previously used models. Cohen’s effect size was calculated as well to observe the effect size statistics as standardized mean differences that exists between quartiles and 95% confidence interval. |

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(Esteban-Cornejo, I., et. Al., 2014)