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The emphasis of physical activity across the curriculum; a positive approach to increased academic achievement

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THE EMPHASIS OF PHYSICAL ACTIVITY ACROSS THE CURRICULUM; A POSITIVE APPROACH TO INCREASED ACADEMIC ACHIEVEMENT

by
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Dedication

I dedicate this manuscript to God for giving me the ability to get this far.

Acknowledgment

I would like to thank all my loved ones for the unconditional patience, support and understanding throughout this process.

Abstract

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The purpose of this study was to assess whether physical activity has an effect on academic achievement in students. The presence of a physically active lifestyle has received much support due to its physiological and mental benefits. The establishment of such a lifestyle should begin at an early age; however, there has been a recent shift away from physically active programming within the school system that could perpetuate a healthier future. Pressure to increase academic achievement has led to the reduction and elimination of opportunities for physical activity, but these actions could have an adverse impact on students (Mahar, Murphy, Rowe, & Golden, 2006).

Voluntary participants (N=108) from a public high school located in the Southern part of New Jersey took part in this study. Each received The Obligatory Exercise Questionnaire, a 20-item scale pertaining to daily physical activity habits. Four demographic questions were asked (age, gender, grade, and ethnicity), along with a question concerning current grade-point average. The data collection that occurred over a one-week period was analyzed to determine whether a relationship was demonstrated between physical activity and academic achievement. Contrary to past research that has demonstrated a link between the two variables, findings within this particular study found no significant difference.

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Chapter 1

Introduction

Need for Study

Obesity is one of the leading public health concerns impacting children, adolescents, and adults alike. An extensive list of additional health risks related to obesity are a major threat for the 17.1% of US children and adolescents cited as being overweight and the 32.2% of adults identified as obese (Ogden et. al, 2006). These health threats are legitimized through the 300,000 deaths that occur each year that are attributed to obesity. This issue extends beyond the individual level as collective implications are apparent in the direct costs accrued in national health care expenditures. Obesity alone accounts for approximately 9.4% of the healthcare cost (Mokdad et. al, 2000). The devastating consequences of this issue bring forth a need to address the causes of obesity. Evidence continuously demonstrates that one main contributor to this epidemic is a lack of adequate physical activity.

The importance of this study was to investigate the significance of physical activity for both physical and mental variables. As obesity is a threat to even the youth, it is important to explore the integration of physical activity at the earliest life stages. The school environment presents the ideal opportunity to involve students in physical activity they may not otherwise engage in outside of school. Unfortunately, budgetary constraints and pressure on both administration and teachers to increase academic achievement scores has led to the reduction and elimination of physical activity opportunities. These actions could adversely impact the original goal of increasing academic achievement scores, and may cause both academic scores and health/ well-being scores to continue to

fall.

Recent research has begun establishing a link between physical and cognitive variables. The benefits of physical activity and fitness are now being understood as extending beyond health and well-being and moving onto favorable cognitive factors. Physical fitness and physical activity have demonstrated improvements in both cognition and concentration; which can lead to positive academic outcomes (Chomitz, Slining, McGowan, Mitchell, Dawson, & Hacker, 2009). The goal of the present study is to examine the relationship between physical activity and academic performance of students and access the need for maintaining physical activities within the school setting.

Purpose

The goal of this study was to determine whether physical activity has an effect on academic achievement in secondary school students. This study reviewed the vast amount of positive health implications credited by physical activity, and introduced recent connections in research between physical activity and academics. As previously mentioned, a number of school districts have reduced or eliminated the integration of physical activity in the curriculum to accommodate for more academic teaching time. The objective of these actions was to increase academic achievement, but this study was designed to explore whether these actions will have an adverse consequence.

Hypothesis

The initial prediction of this study was that physical activity will have an effect on academic achievement. For purposes of this study physical activity is measured through The Obligatory Exercise Questionnaire. The measure of academic achievement is based off of student grade-point average. The hypothesis for the current study was that higher

reported physical activity and exercise habits of students will result in higher academic achievement. More specifically, those students that rate their daily exercise habits as occurring more often will have higher grade point averages in comparison to those students with less frequent exercise habits.

Operational Definitions

Physical activity: any body movement that works muscles and requires more energy than a resting state. The Obligatory Exercise Questionnaire was used as a measure of physical activity within this current study.

Academic achievement: the extent to which a student has met their educational goals. Grade-point average was used as the measure of academic achievement.

Limitations

The current study relies on self-report by students of academic achievement based on grade point average. Due to the fact that school records are unable to be obtained for the assessment of academic achievement, the study depends on the honesty of the participating students in reporting accurate GPA's. Further research studies on this topic should incorporate verified academic reporting in order to validate significant findings.

Assumptions

It is assumed that all participants were honest in reporting daily physical activity on The Obligatory Exercise Questionnaire and accurate in reporting current grade-point average.

Summary

This descriptive design study was formulated as a way to explore the relationship between physical activity and academic achievement. There are well-documented

physiological benefits of physical activity disclosed through years of research, but the aim of this study was to further explore the psychological and cognitive benefits that are less well-known. Data related to daily physical activity habits was collected from 108 secondary school students. Participating students also provided current grade-point average; which served as a measure of academic achievement. The overall hypothesis of the study was that physical activity would have an effect on academic achievement. Analysis of data was conducted to determine whether a significant relationship was found between the two variables.

Chapter 2

Literature Review

Known Benefits of Exercise and Physical Fitness

The physiological benefits of exercise and physical fitness are widely acknowledged and encouraged as a method of reducing the risk of a number of ailments. The U.S. Department of Health and Human Services (1996) has credited physical fitness with decreasing the risk of cardiovascular disease, colon cancer, diabetes, premature death, and obesity. Improvements in bone and musculoskeletal function have also been noted as a benefit of exercise and physical fitness (Sayers, Farley, Fuller, Morgan, & Caputo, 2009).

Psychological variables have also shown improvements as a result of exercise, but are less understood. Depression, anxiety, stress, and self-confidence are all psychological variables that have positively improved through elevated levels of physical fitness activities, as well as improvements in work, recreation, and quality of life (American College of Sports Medicine, 2009). The benefit of physical exercise extends throughout the lifetime as studies have shown improvements in both children and older adults within various facets of life. Stereotypic and disruptive behaviors in children with autism, learning disorders, and behavioral disorders are significantly reduced through physical fitness programs. In older adults, exercise was found to maintain cognitive vitality (Hill et. al, 2010).

Obesity in Children & Adolescents

Childhood obesity is currently one of the most prevalent public health threats of the 21st century (Lee, 2006). The percentage of children that are overweight has more

than doubled, and has tripled for adolescents since 1980. Staggering rates of obesity throughout the nation continues to be on the rise (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). Both physiological and psychological components are at risk for children that are overweight. Health concerns with known relation to obesity in children include high blood pressure, high cholesterol, and type II diabetes. In comparison to children of lower weight categories, children that are overweight are more socially withdrawn, depressed, and anxious (Wittberg, Northrup, & Cotterel, 2009).

Physical Activity Across the Lifespan

There is little doubt that physically active people live an overall healthier life. With this knowledge in mind, it can be assumed that those that engage in physical activity (PA) across the lifespan will reap the most health benefits. There is currently limited longitudinal research that has emerged tracking patterns of physical activity from childhood to old age. Future research on this subject can uncover the maximum benefits for stable PA across the lifespan.

One assessment has been concluded from the limited research that exists about this subject matter; generally active, energetic children become active, energetic adults (Friedman, Martin, Tucker, Criqui, Kern, & Reynolds, 2008). A lifespan longitudinal study was employed for 723 male participants and 554 female participants to examine activity levels throughout various life stages. Data was derived from the Terman Life Cycle Study that began in 1922 and ended in 1977. This allowed for a six-decade timespan that analyzed physical activity during childhood, adulthood, and older adulthood. The question addressed within the study was whether there was consistency in PA levels throughout these time frames. Along with the finding that active children

tended to remain as active adults, it was found that childhood energy levels and activity interests were also somewhat predictive of activity-relevant hobbies later in life.

The importance of this research lies in the urge to introduce physically active behaviors as early in life as possible. With obesity risk factors beginning in the perinatal stage within the maternal-fetal environment, it is crucial to counteract these potential risks that can have devastating effects later in life (Alberga, Sigal, Goldfield, Prud'homme, & Kenny, 2011).

56% of US children 3-5 years are enrolled in child care centers nationwide and are failing to obtain recommended levels of physical activity. Physical activity habits are established early in life and track over time, making it imperative to begin promoting PA during this early phase of life. The promotion of PA as early as the preschool years can be beneficial in the prevention of obesity and also in the establishment of lifelong healthy physical activity habits (Copeland, Kendeigh, Saelens, Kalkwarf, & Sherman, 2012). The benefits of PA amongst preschool age children extend beyond prevention, it also allows for the development of fundamental gross motor skills. Fundamental gross motor skills could be learned through physical activities such as skipping, climbing, or throwing a ball. These behaviors are mutually reinforced as earlier development of motor skills leads to more active children (Williams, Pfeiffer, O'Neill, Dowda, Brown, & Pate, 2008).

The transition between childhood and adolescence has been cited as a period where a significant decline takes place in overall physical activity (Kimm et. al, 2000). Alberga and colleagues (2011) caution that this decline can be significantly harmful because adolescence is a critical period for the potential role in the development and persistence of obesity. The phase of adolescence is marked by many changes in body

composition, insulin sensitivity and growth. The development of effective prevention initiatives that emphasize physical activity in early development is crucial. These actions will help avoid a cycle of the youth that are predisposed to obesity and exercise intolerance throughout their lifespan.

Lack of Adequate Physical Activity

The above benefits of physical activity and exercise encapsulate the many reasons as to why individuals should take part in regular physical activities. Unfortunately, there are a growing number of reasons why there is a lack of adequate physical activity within society today. Low levels of physical activity, especially among children, have been associated with unsafe neighborhoods, shortage of play spaces, increased television viewing, and increased demands for formal schooling (Pellegrini & Smith, 1998).

The school environment presents the ideal opportunity for adolescents to be physically active because of the amount of time spent at school during the day. Approximately 98% of children are enrolled in school in the U.S., and this provides access to children and could enable repeated exposure to health promotion interventions (Donnelly et. al., 2009). Schools are able to reach a large volume of children with physical activities that could include unstructured recess, physical education, and physical activities before, during, and after class time; however, the rates of physical activity in school have seen a decline in recent decades (Kibbe et. al, 2011).

Ideally, school policies could be modified and teachers could be trained to deliver health promotion interventions. The continuity that schools offer would allow for successful interventions to be sustained after the initial intervention and could be circulated throughout school systems, but unfortunately schools become barriers for these

interventions of physical activity. Throughout the school day children are required to sit quietly to receive academic lessons. This typically represents approximately six hours of the school day (Sayers, Farley, Fuller, Morgan, & Caputo, 2009).

The rationale behind the decline in physical activity programming in schools has placed the blame on budgetary restraints and the pressure schools are facing to increase academic achievement scores (Mahar, Murphy, Rowe, & Golden, 2006). The pressure to meet those academic thresholds legislated by "No Child Left Behind Act of 2001" have required some schools to shift resources away from activities that permit physical activity in students and toward more time on academics. 14% of school districts have reported decreasing time for Physical Education (PE) in order to accommodate for more time in Math and English (Rentner et. al, 2006). Another large study in the United States uncovered the fact that less than 4% of elementary schools provide daily physical education, and only 13.7% provide PE at least three days per week (Lee, Burgeson, Fulton, & Spain, 2007). The reduction and elimination of physical activity in the school system may adversely impact the goal of promoting academic achievement as recent research has emphasized the positive impacts of physical activity on increasing concentration, mental cognition, and overall academic performance.

Perceived Benefits and Barriers to Physical Activity

It can be generally assumed that behavior change will not occur unless one perceives the positives of the change will outweigh the negatives (Kim, 2013). As national recommendations call for the youth to engage in physical activity for at least one hour per day, it is important to take into account what motivates and discourages individuals from meeting these physical activity levels (U.S. Department of Health and

Human Services, 2008). Perceived benefits refer to an individual's assessment of positive consequences that will result from the engagement of physical activity. Perceived barriers are those influences that discourage participating in physical activity (Kim, 2013).

Perceived benefits and barriers to physical activity have been assessed across genders to determine whether there is a consistent disparity. Among middle school girls, commonly reported benefits of physical activity included: stay in shape, stay healthy, opportunity to socialize, have fun, increase in energy, and to improve appearance. A consistent barrier reported by middle school females was feeling self-conscious or embarrassed by appearance during physical activity. Other barriers noted included: dislike of sweating, shyness/ low self-esteem, boys' name calling/ taunting, lack of skill, interest/ motivation, and fear of getting hurt**.** Middle school boys' top benefits of engaging in physical activity were to: improve/ or have more athletic skill, stay in shape, and have the chance to play and be active. Minor aches and pains from the activity, tiredness, and too busy were all barriers boys cited to physical activity (Robbins, Sikorskii, Hamel, Wu, & Wilbur, 2009).

The current deficit in the introduction of physical activity as early as the preschool years was discussed earlier. It was established that the integration of physical activity for preschool age children could be beneficial for obesity prevention, the establishment of lifelong healthy habits, and the development of fundamental gross motor skills. In spite of the established benefits of PA for this age group, preschool age children are still not receiving adequate levels of moderate to rigorous physical activity in child-care settings. One recent study disclosed that children in child-care settings are only

involved in vigorous activity for 2-3% (12-46 minutes) of the day (Pate, McIver, Dowda, Brown, & Addy, 2008).

Copeland and colleagues (2012) investigated the reasoning behind this phenomenon by assessing the perceived benefits and barriers of children's physical activity according to the "gatekeepers" to physical activity, teachers and childcare providers. These individuals are considered the "gatekeepers" because of their direct responsibility in determining whether children engage in physical activity throughout the day. The purpose of the study was to determine whether attitudes about physical activity from staff members constitute the amount of PA the children would take part in.

Nine focus groups and thirteen one-on-one sessions were conducted with 49 childcare teachers and providers in Cincinnati, Ohio. Focus group sessions and interviews included questions concerning three overarching themes: (i). Perceived benefits of physical activity and outdoor play, (ii). Perceived disadvantages/barriers to physical activity and outdoor play, and (iii). Decisions regarding outdoor play and their roles on the playground. An example of questions used during the session include: *What are some types of activities that children in your center engage in that increases their heart rate? What are some possible benefits to children being outside? In your opinion what is the role of physical activity or active play in childcare?*

Perceived benefits of physical activity and outside play fell into two categories: physical and socio-emotional. Benefits identified by teachers and childcare providers included obesity prevention, a method of stress-relief or calming mechanism for children, improvement in children's mood, and a way of forming healthy habits. Other individuals indicated that outside play allowed for brief exposure to fresh air, which allowed children

to escape germs. Perceived disadvantages and barriers to children engaging in physical activity and outdoor play included: children getting sick if not dressed properly, teachers not enjoying the outdoors (not liking getting dirty/sweaty, insects, or chaos and noise on playground), and finally the workload involved in getting children ready to go outside. A few individuals noted their own ailments (allergies/asthma) or being overweight as impediments on their willingness to take children outside and encouraging physical activity. The participants weighed the benefits and barriers in making the decision to allow children to engage in outdoor play. Overall, teacher's attitudes and beliefs about physical activity influenced the behaviors of the children they care for because these children are entirely dependent on their caregivers for opportunities to be active. The authors of this study stressed the tremendous impact teachers and childcare providers can have on increasing children's activity levels, which can lead to positive long-term health implications.

Understanding the cognitive benefits and barriers of physical activity for the youth is an essential component in working towards reaching recommended health standards. The recognition of these reasons why individuals are motivated to participate in physical activity may bring about even greater motivating factors. Also, the consideration of barriers to physical activity for the youth can be utilized to develop better physical activity strategies related to perceptions that will encourage individuals to engage in greater participation.

Neurological Implications of Physical Activity

Current research is beginning to establish a link between physical and cognitive variables, specifically a relationship between physical activity and cognitive function.

One noted study by Hillman and colleagues (2009) examined the effect of acute treadmill walking on cognitive control and academic achievement of preadolescent children. Twenty preadolescent children were fitted with a heart rate monitor and participated in a resting session and aerobic exercise session. The resting session consisted of a twenty-minute seated period, followed by the administration of a modified flanker task and the Wide Range Achievement Test 3 (WRAT3). The aerobic exercise session involved twenty-minutes walking on a treadmill at 60% of estimated heart rate, followed by both the modified flanker task and WRAT3 once the heart rate returned to within 10% of pre-exercise levels. The analysis of data from both sessions revealed improvements in response accuracy, larger P3 amplitude (an event related potential elicited in the process of decision making), and better performance on academic achievement tests following the aerobic exercise in comparison to the resting session. These findings suggest that single, acute bouts of moderately intensive aerobic exercise may improve cognitive control of attention.

Chronic physical activity has been found to impact brain plasticity. Brain plasticity is the ability of the brain to adapt, adjust, and respond to a new situation, environment, or stress (Ferris, Williams, & Shen, 2007). Alongside brain plasticity, the importance of exercise and physical activity has been associated with cognitive development, mood state, memory, and learning. Animal research has revealed that enriched environments (including access to exercise equipment) have a positive effect on both neuronal growth and the neuronal system that is involved in learning and memory (Vaynman & Gomez-Pinilla, 2006).

Increased levels of norepinephrine, dopamine, and serotonin in the prefrontal

cortex, hippocampus, and striatum are a result of physical exercise and impact both cognitive functioning and mood (Ma, 2008; Meeusen & De Meirleir, 1995; Paluska & Schwent, 2000). Dopamine increase can result in enhanced attention, focus, and the acquisition to facilitate learning. Increases in norepinephrine improve executive operations, reduce distractibility, enhance memory, and modulate arousal; which all assist in learning (Wigal, Emmerson, Gehricke, & Galassetti, 2012).

Advances in neuroimaging techniques have also shown that exercise leads to evident changes in brain structure and function. Greater amounts of regular physical activity have observed benefits to cognitive processes that are related to the allocation of attentional resources and faster cognitive processing during stimulus encoding in the brain. (Hillman, Erickson, & Kramer, 2008). Brain-derived neurotropic factor (BDNF), which is associated with the generation of brain tissue, has been found to increase with exercise. These increases may contribute to improvements in measurable behaviors' like concentration, hyperactivity, and impulsivity (Barnard-Bark, 2011). These findings allow for a better understanding of the positive physiological impact physical activity can have on cognitive variables.

Through the use of Functional Magnetic Resonance Imaging (fMRI), Davis and colleagues (2011) observed significant group differences in two regions of the brain as a result of physical activity. 171 children (ages 7-11) identified as being overweight participated in this study, and were randomly assigned to either: (1) Low dose exercise group (20 minutes/day of aerobic exercise), (2) high dose exercise group (40 minutes/day), or (3) no exercise group. A standardized psychological battery assessed cognition and achievement for both baseline and posttest. Conclusions that emerged from

the standardized battery revealed that exposure to either a low or high dose exercise program resulted in higher planning scores. In comparison to the control group that did not participate in any exercise program, planning scores were 3.8 points higher for those in either dose program. No effects were uncovered for attention, simultaneous, or successive scales. The second phase of the study incorporated the use of the fMRI. 20 of the above participants completed another measure of executive function while data was collected from the fMRI. Increased activity in the bilateral prefrontal cortex was apparent for the exercise group, alongside decreased activity in the bilateral posterior parietal cortex.

Executive Function

Executive function is required in planning and selecting strategies to organize goal-directed behaviors, updating working memory, shifting from one mental state to another, and inhibiting impulse behavior. A child that cannot effectively perform these executive functions is unlikely to be able to stay on task.

A meta-analysis by Tomorowski et al. (2008) examined the relationship between the above executive functions and physical activity. Two studies were referenced in support of the executive function hypothesis. Kramer et al. (1999) evaluated the impact of aerobic exercise training on both executive and non-executive cognitive processes in older adults. Results indicated those that participated in aerobic exercise performed tests that required executive function more rapidly and effectively compared to non-exercisers. Colcombe et al. (2004) used Magnetic resonance imaging (MRI) to assess the brain functions of 29 sedentary older men prior to and following a 6-month aerobic walking program. Findings indicated that physical activity modified brain function in the anterior

cingulate cortex (a prefrontal cortical area implicated in regulation and control of behavior). Participants in the intervention group demonstrated faster complex decision-making following the 6-month aerobic walking program. Tomporowski et al. (2008) has used conclusions from both studies to predict exercise-related improvement in children's cognitive function.

Programs Implemented into the School Environment

Findings from a recent review of physical activity and academic achievement revealed that eight out of nine studies found a positive association between classroom-based physical activity and indicators of cognitive skills and attitudes, academic behavior, and academic achievement (Kibbe et. al., 2011). A number of programs have been developed as a method of incorporating physical activity into the classroom, while assessing the physical and mental repercussions.

The TAKE 10! program was developed by the non-profit organization, International Life Sciences Institute (ILSI) as a component of the Physical Activity and Nutrition (PAN) program. ILSI has worked since 1996 to promote physical activity and to formulate practical solutions that impact obesity-related behaviors in children (Kibbe et al., 2011). TAKE 10! was created in 1999 as a method of reducing sedentary behaviors during the elementary school day and to increase daily activity levels and structured minutes of PA in the classroom. The program integrates both PA and academic learning as students engage in 10-minute physical activities while specific learning objectives in math, reading, language arts, science, social studies, and general health are all reinforced. "Contraction Action" is one example of a TAKE 10! activity that can be implemented into the second grade setting. This activity incorporates both PA and academics as

students sing and perform two-part muscle contraction movements to better understand how two words becomes a contracted word. Variations of the TAKE 10! Program have been introduced and examined throughout the nation.

Holler and colleagues (2010) evaluated the impact of one variation of the TAKE 10! program, the Healthier Options for Public Schoolchildren (HOPS) initiative, on 1197 students in Florida. The HOPS program is an obesity prevention program created to target low-income elementary school students between the ages of 6-13. The program combines both nutrition and physical activity components. The goal of HOPS was to improve overall health and academic achievement. A quasi-experimental elementary school based prevention intervention was implemented into five elementary schools in Osceola County, FL over the course of two years. The Florida Comprehensive Achievement Test (FCAT) was used as a measure of academic achievement pre and post intervention for all participants. The intervention period resulted in significantly higher FCAT math scores in comparison to the control group for the 2004-2005 and 2005-2006 school years. Improvements in math scores were consistent among all ethnic groups, but Hispanic students showed the greatest improvement with a 20-point gain in FCAT math scores.

The effectiveness of a combination of the Coordinated Approach to Child Health (CATCH) and classroom based TAKE 10! activities were evaluated in 2008 by Murray and colleagues. 932 third and fourth grade students from eight Texas elementary schools participated in the program. As a measure of academic achievement, the Stanford 10 test was administered in September/October 2005, May 2006, and December 2006 to assess abbreviated reading comprehension and math problem solving. For those that participated

in the combined CATCH and TAKE 10! program, there were significantly higher math scores reported over time in comparison to the control group. Reading comprehension scores also revealed a significant improvement, but at a similar rate as the control group.

Physical Activity Across the Curriculum (PAAC) is a third variation of the TAKE 10! program that has been applied and reviewed to evaluate changes in academic achievement for reading, writing, mathematics, and oral language skills. Twenty-four elementary schools in Northeast Kansas were cluster randomized to either participate in the PAAC intervention or control group. The timespan of the study by Donnelly and colleagues (2009) followed participants from grades two and three to grades four and five. The PAAC program promoted 90 minutes per week of moderate to vigorous intensity physical activities that promoted academic lessons provided by the classroom teacher. The Wechsler Individual Achievement Test- 2nd Edition was used to measure academic achievement. From baseline to year three, significant improvements were found in the academic areas of reading, math, and spelling for the intervention group (Donnelly et al., 2009).

The "Energizers" program is a short classroom based physical activity program developed by East Carolina University Department of Exercise and Sport Science. The formation of the program was in response to the 2005 North Carolina State Board of Education mandate for schools to provide a minimum of thirty minutes of daily physical activity for all K-8 students. Allowing students to stand and move around during academic instruction provides the opportunity to increase daily physical activity levels. Energizer activities last approximately 10-minutes and integrate grade appropriate learning materials. These activities require no equipment and little teacher preparation.

Mahar and colleagues (2006) evaluated the effects of the "Energizer" classroom based physical activity program and on-task behavior during academic instruction for 243 students in grades K-4. Significant findings supported the initial hypothesis that a classroom based physical activity programs would improve on-task behavior for students. Even the least on-task students improved on-task behavior by 20% after the implementation of the intervention.

Programs that promote physical activity within the classroom have also begun to emerge internationally. CEP was developed by the Curriculum Support Team for Physical Education, Health, and Well-Being in Aberdeen City, located in Northeast Scotland. The basis of the program allowed students to engage in both stretching and aerobic activities ten to fifteen minutes throughout the day while standing behind their desk. The standard for the physical activity was moderately intensive for the average student. Six primary schools participated in the study, with a complete sample size of 1224 children ranging between the ages nine to eleven years old. Cognitive tests that measured paced serial addition, size ordering, listening span, digit span backwards, and digit symbol encoding were used as the measure for academic achievement. Findings indicated that children's performance on a set of attention demanding cognitive tests improved as a result of CEP (Hill et. al., 2010).

The recognition of the many benefits of physical activity programs within the classroom has led to some states passing coordinated school health or physical education/ physical activity policies mandating a specific number of minutes per week. Successful programming has been seen after the state of Tennessee mandated 90 minutes of PA per week for elementary and secondary school students back in 2006. The law explicitly

states that PA must occur during the "instructional day" and makes clear distinctions between physical education and physical activity. Following this state mandate, a combination of the Coordinated School Health (CSH) and TAKE 10! program was adopted within the school systems. For the 2008-2009 school year, the state has seen over 8,000 fewer children classified as overweight or obese compared to the previous year. The percentage of obese and overweight students has dropped from 40.9% to 39.0%. These improvements indicate the importance of state leadership in providing guidance to local districts on how to implement a state law for the health of all students.

The Federal Government has also joined in on the initiative to promote health and wellness during the school day. The "Let's Move" movement has become widely recognized through the work of first lady, Michelle Obama since the campaign was unveiled on February 9, 2010. The program is described as a way to "put children on the path to a healthy future during their earliest months and years" (www.letsmove.gov). Providing healthier options for food in schools, ensuring families have access to healthy and affordable food, and helping children become more physically active are all goals of "Let's Move" (Wojcicki & Heyman, 2010).

In 2003, Naperville Central High School in Illinois recognized that some of their students were performing below grade level because of reading skills. To address this issue, the school formed academic reading classes alongside a before-school P.E. program based on research indicating higher physical activity in students relates to academic alertness. This became known as the Learning Readiness P.E. (LRPE) program. Twenty minutes of cardio exercise is included into every P.E. class, and students wear heart monitors to ensure they are reaching their targeted heart rate zone. The program

aligns P.E. with the specific learning needs of individual students. For example, P.E. will be scheduled before math or reading classes for students that experience difficulties in those areas. The goal is to elevate the heart rate of students before the most difficult classes. An important aspect of the program is educating students about the necessity for fitness and wellness within a daily lifestyle.

Since the inception of LRPE in Naperville, students that have participated in the program have demonstrated significant improvements in both literacy and mathematics. Participants with P.E. before pre-algebra have improved two to four times more on standardized tests in comparison to past testing before the program. Also, those that have scheduled P.E. directly before reading comprehension read half a year ahead of other classmates (Iskander, 2011).

Guidelines for Educators

The basis behind Naperville High School's LRPE program directly aligns with the work of the organization *Sparking Life. Sparking Life* is a non-profit and international movement working towards re-engineering school practices and medical recommendations to establish curriculum, lifestyle, and corporate practices. The work is based on research that has confirmed physical activity and exercise enhances brain development and improves mental health. The program was founded by Dr. John J. Ratey, an Associate Clinical Professor of Psychiatry at Harvard Medical School, and colleagues. One of their initiatives is the emphasis on school districts implementing PE programs before and during the instructional day. These PE programs should not only increase levels of physical activity, but should also optimize learning, improve motivation, activate impulse control, moderate mood, and build self-esteem. The

Sparking Life website lists a number of recommendations for educators as new PE programs are developed.

The first guideline is for the major attentional- shift needed. Educators are encouraged to re-think traditionally low value physical education programs, and to heighten prominence and visibility by using PE as a tool to enhance learning and teaching. It is also recommended that a "Sports" focus in PE programming should be transitioned into a "Physical Fitness" focus. The correlation between exercise and cognition should be acknowledged, promoted, and acted upon amongst the school community as a whole. Students should be encouraged to incorporate non-disruptive physical movement during and throughout regular academic classes. One final component in shifting attention is to view exercise as a powerful modulator of negative conditions that can inhibit academic and social success in students (ADHD, anxiety, stress, depression).

The next consideration includes intensity and duration of exercise. Previous research has revealed that many schools fail to attain sufficient high intensity physical activity and remains far too infrequent during the school day. Rigorous physical activity has tremendous physical and mental benefits. Scheduling of physical activity throughout the school day is another crucial consideration. Careful planning and regulation of timing for physical education and activity throughout the school day should take place for each student. Maximum behavioral and cognitive benefits to physical activity emerge when PA is applied early and often each day.

Spark Life has suggested making exercise fun, and not "boot camp" as a guideline for educators. Physical activity should be fun, student-driven, and culturally relevant in

order to encourage all students to participate. Feedback about various types of activities should be sought from students to gage rates of interest. Along with fun and relevant activities, PA activities should also be voluntary when appropriate. Studies have indicated that voluntary participation in culturally relevant activities outperforms involuntary activities. Students should receive quick and timely immediate feedback about their personal fitness levels, and education on how their current fitness can potentially impact academic performance and quality of life.

Physical activity that incorporates components of balance is beneficial when designing a program. Those exercises and activities that focus on balance train a different part of the brain (cerebellum) and can create a more enriching learning experience for all students. When possible, outdoor activity can provide an environment that is elevating for sensory perception and will increase the demand on mental complexity. Students must make choices involving routes, experience unevenness of land, and must make use of balance and coordination much more often compared to when indoor activities take place.

One final consideration in the development of physical activity programming in the school environment is equipment, supplies, and funding. Educators are cautioned to remember that expensive does not always equate to superior. Full student participation and acceptance has been achieved through completely free student-teacher collaboration programming.

An increasing number of reports have indicated that participation in physical activity benefits a host of cognitive processes. These results should be considered as federal and statewide scrutiny has placed greater demands on school districts for

increased performance on academic achievement tests. Various examples of physical activity programs that are yielding positive results for academic achievement have been implemented nationwide. Future research should continue to assess the role of physical activity on physical, cognitive, social, and academic factors. As this particular field of research continues to grow, other variables such as age, gender, culture, and socioeconomic status should also be taken into account for the evaluation of the relation between physical activity and academic achievement.

Chapter 3

Methodology

Participants

Participants (N= 108) in this study were students recruited from a four-year comprehensive, public high school located in the Southern part of New Jersey. The age of students ranged from 15 to 18 years old, and encompassed students from grades 10 through 12. 33 male and 75 female students took part in this study. Participating students identified as belonging to a number of different racial groups: White, Asian, Hispanic, Black, Pacific Islander, and Other.

Materials

Collection of data took place over a two-day period during the winter of 2015. The Obligatory Exercise Questionnaire was used as a measure of physical activity for purposes of this study. The 20- item scale was modified from the original Obligatory Running Questionnaire (Blumenthal, O'Toole, & Chang, 1984). The scale was constructed as a measure of obligatory exercise level, and employs a four-point choice format. The questionnaire has been psychometrically evaluated and found to have an alpha value of .96. Items reflect subjective need to engage in repetitive exercise behaviors. Answers regarding this need range from one (never), two (sometimes), three (usually), and four (always). The scale was validated through a correlation of two Likert scales that measured subjective level of anxiety if unable to exercise and probability of exercising despite painful injury (Pasmen & Thompson, 1988). LePage and colleagues (2012) also employed the use of the Obligatory Exercise Questionnaire and found it to have good internal consistency and good test-test reliability (two weeks, 0.96).

The Unweighted GPA grade conversion scale was used to measure academic achievement of participants. The scale was found in the school's 2014-2015 academic profile, and is based on the current grading system. Three different grade values are provided on the scale: (1) Percentage average (0-100), (2) Numerical GPA (0-4.3), (3) Letter grade average (F-A+).

Design

A descriptive design was used for this study. The two variables examined were: (1) physical activity and (2) academic achievement. Measures of these variables incorporated the use of the Obligatory Exercise Questionnaire to assess physical activity. Grade-point average was collected as a measure of academic achievement. Pearson Correlation assessed the relationship between the variables during the data analysis process. Participants were also grouped into five sections relating to GPA for purposes of performing a one-way ANOVA. Each group of students was defined based on reported grade-point average: 97-100 range (Group 1), 93-96 (Group 2), 90-92 (Group 3), 87-89 (Group 4), and 83-86 (Group 5). The one-way ANOVA was employed as a method of determining if there were any differences in physical activity scores between groups.

Procedure

To obtain access to subject pool, permission was granted from the superintendent, principal, and teachers of the participating school. The Rowan University Institutional Review Board approved this Social and Behavioral research study. Meeting dates and times were coordinated with three individual teachers to spend 10-15 minute sessions in each of their scheduled classes on two different occasions. The initial session with students provided an overview of research and time to answer any questions those

interested in participating might have had. Those students that volunteered to participate received a parental consent form to return upon the next meeting.

All signed parental consent forms were collected at the start of the second and final session with students. Returned consent forms received a numerical code that coordinated with the code on the questionnaire form in order to ensure confidentiality. Participants were given an opportunity to ask any questions that had come to mind before beginning the questionnaire. After the question/ answer portion of the session, students that returned parental consent received the questionnaire form. The duration of time needed for the questionnaire lasted approximately 5-10 minutes.

Chapter 4

Results

Demographic Data

To examine the role of physical activity on academic achievement, 108 Obligatory Exercise Questionnaires were administered to students attending a public high school in South Jersey. Out of the total number of questionnaires administered, five questionnaires were invalid due to missed questions. Further analysis led to the exclusion of two additional participants because of outlier scores in comparison to the group of data as a whole.

The ratio of male to female students involved in this present study was 32:69, with 32% of the population being male and 68% female. Students in grades 10-12 served as participants, and ranged in age from 15-18 years old. When indicating race, the students identified as belonging to various racial groups: White (50.5%), Asian (23.8%), Hispanic (14%), Black (5%), Other (5%), and Pacific Islander (2%).

Statistical Analysis

Data analysis took place in order to test the present study's hypothesis that physical activity will have an effect on academic achievement. The analysis process determined whether or not the participants in the current study (N=101) that reported higher physical activity and exercise habits have a higher grade point average. The initial step of the data analysis process began with inputting scores of the Obligatory Exercise Questionnaire into a Microsoft Excel spreadsheet, alongside reported grade-point average scores. For purposes of testing, participants were also grouped into five sections relating to GPA: 97-100 range (Group 1), 93-96 (Group 2), 90-92 (Group 3), 87-89 (Group 4),

and 83-86 (Group 5). Following the initial organization of data, all data was transferred into the program SPSS. In order to test for a correlation between physical activity scores and GPA, a Pearson Correlation test was run on the collected data for the 101 participating students. Mean scores for physical activity (M= 46.55) and GPA (M= 91.32) were found for the total number of participants. The two-tailed significance score of .606 revealed no significant difference between physical activity and GPA. A One-Way Analysis of Variance (ANOVA) test was also performed to assess the relationship between physical activity scores and GPA. Mean scores were found for each of the groups: Group 1 (M= 43.00), Group 2 (M= 47.90), Group 3 (M= 46.33), Group 4 (M= 46.28), and Group 5 (M= 44.85), as shown in Table 1.

Table 1

Mean scores of participating students based on GPA group

Group	N	Mean
1	5	43.00
2	38	47.90
3	27	46.33
4	18	46.28
5	13	44.85
Total	101	46.55

The One-way ANOVA uncovered no significant difference among the five groups with a two-tailed significance level of .813.

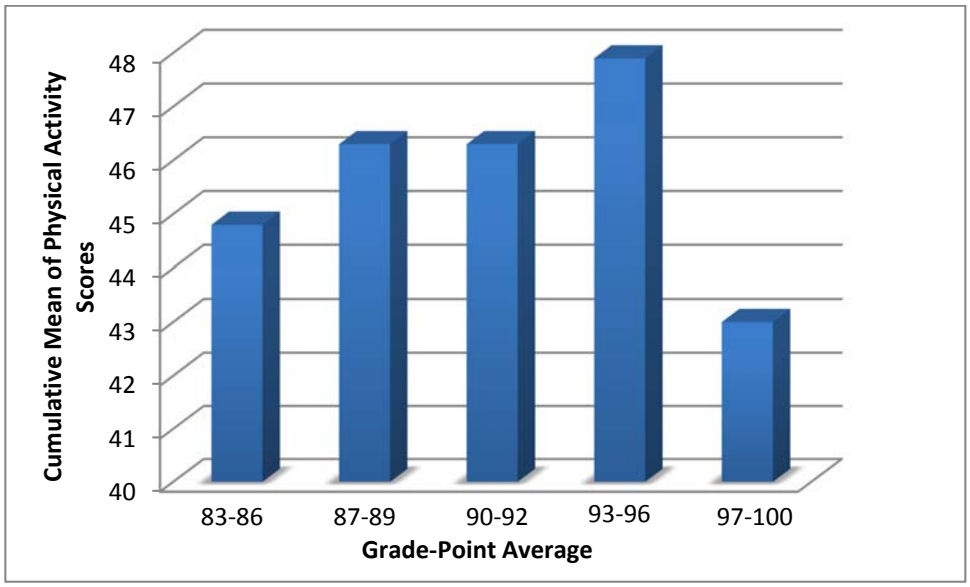

Figure 1. Cumulative mean scores of physical activity among GPA groups.

Chapter 5

Discussion

A review of literature and past research reveals the positive implications of physical activity in the school setting. Physical activity has been credited with increasing concentration, mental cognition, and overall academic performance (Chomitz, Slining, McGowan, Dawson, & Hacker, 2009). The purpose of the present study was to examine the relationship between physical activity and academic performance among the participating high school students (N=108). Within recent years there has been a trend in the reduction and elimination of physical activity opportunities for students (Kibbe et al, 2011). Research findings within this study were sought to assess the need for maintaining physical activities within the school setting.

Physical activity scores were collected through the Obligatory Exercise Questionnaire and analyzed alongside reported grade-point average. The parametric testing of a One-Way ANOVA and Pearson Correlation evoked comparable results with no significant difference found between the two variables. Higher levels of physical activity did not relate to higher grade-point average among the students that participated in this study. These findings pertaining to the sample population did not align with much of the research supporting the promotion of academic achievement through increased physical activity.

In hindsight, the Obligatory Exercise Questionnaire did not seem to be an adequate measure of physical activity for this particular study. Favorable results may have been found if a different apparatus was chosen at the initiation of the study. The questionnaire was constructed as a measure of obligatory exercise level, whereas this

study should have employed the use of an apparatus that strictly measured frequency of physical activity. Scoring from the questionnaire may have closely reflected participants' attitude towards physical activity rather than participation. Questions such as number 15, *sometimes my mind wanders to thoughts about exercising,* emphasize an emotion-based response towards exercise. Although a participant may not necessarily have thoughts about exercise on a frequent basis, it is possible that they engage in physical activities more often than someone with those thoughts. The decision to make use of the Obligatory Exercise Questionnaire may have produced results that did not correspond to previous work.

The extensive review of past research has confirmed the vitality of physical activity for the enhancement of overall health. The physiological benefits of physical activity have been clearly defined over the past decades, but the recent understanding and emphasis of cognitive benefits is still a fairly new area of research. Although the results of this study are inconsistent with a collection of studies that have demonstrated the academic benefits of physical activity, this study contributes to the advancing field of research that is now addressing physical activity and cognitive variables. Bass and colleagues (2013) published a study with a similar purpose in the assessment of the relationship between physical activity and academics and uncovered a positive relationship between aerobic capacity and muscular endurance and academic performance. The FITNESSGRAM test battery assessed five components of health related fitness within 838 middle school students, and was compared with the results of The Illinois Standardized Achievement Test (ISAT). Data analysis concluded that boys that fell into the category of Healthy Fit Zone for aerobic capacity and muscular

endurance were 2.5-3 times more likely to pass their math or reading exams. Girls in the Healthy Fit Zone for both categories were 2-4 times more likely to meet or exceed reading and math test standards. Research results such as these emphasize the necessity in maintaining physical activity opportunities throughout the school day.

Given the pressure that educators and policy makers are facing to achieve high academic standards for the student body as a whole, it is essential to understand the relationship of academic success and physical activity. The allocation of resources towards physical activity programming within the school environment may be the proponent needed to increase academic achievement (Chomitz, Slining, McGowan, Dawson, & Hacker, 2009). The supportive role for physical activity on school performance found in recent research should warrant the maintenance of these activities within schools.

Limitations

The present study relied on self-report by participating students for both measures: physical activity and academic achievement. Due to the fact that school records were unable to be obtained for the assessment of academic achievement, this study depends on the honesty of the reporter. This aspect of self-report exposes the research to potential limitations. Sample size was a second limitation within this particular study. A larger sample population may have unveiled differing results that could have potentially supported the hypothesis that students with higher reported physical activity habits would have a higher grade-point average.

Future Research

Additional research should continue to investigate the relationship between physical activity and academic achievement. The small body of research that currently exists concerning the relation between the two measures needs to be expanded. Additional attention is also needed in the identification of the forms of physical activity that could produce the greatest cognitive implications. The application of future research findings regarding this topic could potentially benefit the school environment as a whole.

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