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Alternative methods of movement incorporation in middle school classrooms

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By

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Physical inactivity is linked with several chronic disease. This study has a twofold purpose: first, to examine the effect bouncing feet on a band have on middle school student's physical activity level. Secondly, to examine the relationship between fidget behavior and academic engagement. Sixth grade English classrooms (2) from a local middle school participated in the study. All students were issued a physical activity monitor to be worn on their, and during the intervention, an under-the-desk apparatus was provided to students to freely fidget. Total sedentary time increased during intervention. Use of under-the-desk band did not positively or negatively impact academic engagement. Final analysis included 19 participants. Significant increase in sedentary time and percentage of class spent in sedentary were found. As well as significant decrease in light time, percentage of light, percentage of moderate, percentage of vigorous. The use of an under-the-desk band does not negatively impact academic engagement.

DEDICATION

To my loving husband and family, who have been my biggest support through my degree and my life. I would not be where I am today without you. Thank you for always encouraging me to pursue my dreams and never give up.

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CHAPTER I

INTRODUCTION

Since 1990, the Department of Health and Human Services has released updated goals and objectives for the next ten years, to promote quality of life, healthy behaviors, and healthy development across all stages of life (U.S. Department of Health and Human Services., 2014). In an effort to achieve these goals, researchers developed the first set of Physical Activity Guidelines for Americans in 2008. In Fall 2018, the Department of Health and Human Services released updated guidelines. The current guidelines stipulate children should participate in a minimum of 60 minutes a day of moderate to vigorous physical activity with vigorous activity occurring at least three days a week (Piercy et al., 2018). The updated guidelines highlight the importance of encouraging school-aged youth to participate in age appropriate, enjoyable physical activity that offers variety (Piercy et al., 2018).

Just prior to the release of the updated guidelines, the 2018 Physical Activity Advisory Committee detailed areas for future research. One specific area for future research in children and adolescents was conducting intervention studies to examine the effect of reducing sedentary behaviors can have on health outcomes (2018 Physical Activity Guidelines Advisory Committee., 2018). Physical inactivity is a modifiable risk factor in children and adolescents for several chronic diseases, including cardiovascular disease, obesity, and diabetes (Cote, Harris, Panagiotopoulos, Sandor, & Devlin, 2013; Ross, Yau, & Convit, 2015).

Childhood obesity is defined as a body mass index (BMI) at or above the age-and-gender-specific 95th percentile (Holmes & Spring, 2018; Kuczmarski et al., 2002) and is predictive of adult obesity (Morrison, Friedman, & Gray-McGuire, 2007). Metabolic syndrome (MetS), is the clustering of risk factors, including hyperglycemia, hypertriglyceridemia, low high-density lipoprotein with obesity (Hsu et al., 2011; Huang, 2009) A set definition has not been established in children, because MetS is progressive and clinical symptoms are usually not present until later in life (Holmes & Spring, 2018). Individuals diagnosed with childhood obesity are at an increased risk for MetS as an adult (Cook, Auinger, Li, & Ford, 2008; Cruz & Goran, 2004; Hsu et al., 2011; Weiss et al., 2004). Research has found an inverse relationship between physical activity and childhood obesity (Nader, Bradley, Houts, McRitchie, & O'Brien, 2008). A similar relationship between physical activity and MetS has been demonstrated in children (Hsu et al., 2011; Steinberger et al., 2009).

Physical activity is beneficial for more than just metabolic health. Individuals with higher aerobic fitness levels tend to perform better academically, including on standardized tests (Coe, Pivarnik, Womack, Reeves, & Malina, 2012).The passing of "No Child Left Behind Act" and "Every Student Succeeds Act", has placed an emphasis on standardized testing schools, diverting recourses from physical activity, and decreasing opportunities to promote better health in schools (Black, 2017; Mahar et al., 2006; Ryan, 2004). Due to the sedentary nature of a typical classroom environment and lack of physical activity in many classes, researchers have studied several modes of movement incorporation (Bartholomew & Jowers, 2011; Grieco, Jowers, Errisuriz, & Bartholomew, 2016; Webster, Russ, Vazou, Goh, & Erwin, 2015). Movement incorporation methods are diverse and range from prefabricated lessons (Donnelly et al., 2009) and activity breaks (Whitt-Glover, Ham, & Yancey, 2011) to allowing students to freely fidget

(Donnelly et al., 2009; Fedewa, Davis, & Ahn, 2015; Whitt-Glover et al., 2011). Physical activity in the classroom is linked to improvements in academic performance and on-task behaviors (Ahamed et al., 2007; Chomitz et al., 2009; Erwin, Fedewa, Ahn, & Thornton, 2016; Mahar et al., 2006). Most of the research to date has focused on the prefabricated programs or activity breaks in elementary and high school classes. During adolescence, many individuals develop behavioral habits that can carry into adulthood (Park, Scott, Adams, Brindis, & Irwin, 2014). The purpose of this study is twofold: firstly, to examine the effect alterative movement incorporation methods, such as fidgeting, have on physical activity levels in middle school students: and secondly, to examine the relationship between fidgeting and academic engagement.

Researchers anticipated there would be a significant increase in physical activity levels, due to the use of an under-the-desk band, when comparing the intervention and control times. Further, it was anticipated the bulk of the increases will be due to an increase in light physical activity. Additionally, researchers propose that a positive relationship would exist between fidgeting behaviors and academic engagement.

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CHAPTER II

LITERATURE REVIEW

Physical activity is an important aspect of health in adults and children. Increases in time spent partaking in sedentary behaviors is linked to several chronic diseases (Martin & Murtagh, 2015). The modern work place severely limits time available for physical activity (Koepp, Moore, & Levine, 2017). Research observes similar trends in classrooms, often due to an emphasis on standardized testing (Grieco, Jowers, Errisuriz, & Bartholomew, 2016; Koepp et al., 2017). Physical activity recommendations for children are 60 minutes a day of moderate-to-vigorous aerobic physical activity (Piercy et al., 2018). Most children spend a minimum of 7 hours a day in school, the greater part of which is spent physically inactive (Grieco et al., 2016; Mahar et al., 2006). Because students spend most of their time in school, it is an ideal target for intervention. Thus, scientists have proposed several suggestions to incorporate movement directly in the classroom.

Movement incorporation methods range from activity breaks (Whitt-Glover, Ham, & Yancey, 2011) to a merger of the lesson and physical activity (Grieco et al., 2016; Resaland et al., 2016). Previous research in adults (Koepp et al., 2017; Levine, Schleusner, & Jensen, 2000) and some preliminary research in children (Erwin, Fedewa, Ahn, & Thornton, 2016; Fedewa, Davis, & Ahn, 2015) has shown fidget behaviors could serve as a viable means for movement incorporation. This review examines the current research for movement incorporation methods and is organized into the following sections: (i) the relationship between obesity, metabolic syndrome, physical activity in children; (ii) the importance of physical activity in schools; (iii) movement incorporation methods; and (iv) conclusions. This review serves to provide researchers and schools with information of pathways to incorporate more movement into classrooms by thoroughly evaluating the evidence of efficacy and logistical implementation

Obesity, Metabolic Syndrome, and Physical Activity

Childhood obesity is defined as a BMI at or above the age-and-gender specific 95th percentile (Holmes & Spring, 2018; Kuczmarski et al., 2002). Children diagnosed as obese have elevated risks for cardiovascular disease (Cote, Harris, Panagiotopoulos, Sandor, & Devlin, 2013; Ross, Yau, & Convit, 2015), adult obesity (Power, Lake, & Cole, 1997) and insulin resistances (Katzmarzyk et al., 2004). Besides the negative physiological outcomes impacting obese children, the psychological outcomes can have more of an immediate consequence on the individuals quality of life, often due to bullying from peers (Mellin, Neumark-Sztainer, Story, Ireland, & Resnick, 2002; Schwimmer, Burwinkle, & Varni, 2003; Zametkin, Zoon, Klein, & Munson, 2004). Current prevalence of childhood obesity in the United States stands at 17% but has remained relatively stable since 2011 (Ogden, Carroll, Kit, & Flegal, 2014). Obesity prevalence for the specific age group of adolescents (ages 12-19) is at 20.6% according to National Health and Nutrition Examination Survey (NHANES; (U.S. Department of Health and Human Services., 2017). In Mississippi, prevalence of overweight and obesity in adolescents is 13.2% , and 15.4% respectively. Only 25.9% of adolescents meet the aerobic physical activity guidelines. The majority of obese children remain obese across several decades (Gordon-Larsen, The, & Adair, 2010). Furthermore, childhood obesity increases risk of developing metabolic syndrome during childhood (Cook, Auinger, Li, & Ford, 2008; Cruz & Goran, 2004; Weiss et al., 2004).

Metabolic syndrome (MetS) in adults is defined as having at least three of the following: obesity hyperglycemia, hypertriglyceridemia, low HDL-cholesterol, and hypertension (Hsu et al., 2011; Huang, 2009). Using age-adjusted adult criteria, MetS prevalence rates in obese children range from 12.4% to 44.2% (Cook et al., 2008). In children, no set definition for MetS exists because it is a progressive disease, and many of the risk factors do not clinically present themselves until later in adulthood (Holmes & Spring, 2018). Never the less, the origins of this adult disease begin during childhood and researchers have begun to consider the clustering nature of these risk factors in children by using a "metabolic syndrome score" from age standardized residuals (Eisenmann, 2008), thus, allowing researchers to examine how different interventions may affect metabolic syndrome. This technique is limited to comparisons solely within individual study samples. Use of the summary score, however, does allow each subject to have a continuous value that is statistically sensitive and less prone to error, allowing researchers to show links between exposers and MetS. In addition to childhood co-morbidities, childhood obesity appears to be a primary predictor of adult onset cardiovascular disease and metabolic syndrome (Lau, 2009; Morrison, Friedman, & Gray-McGuire, 2007). A follow-up study to the Princeton Lipid Research has found that children who were diagnosed as obese had a 6.2 times greater risk of developing MetS as an adult and 14.6 times greater risk of developing cardiovascular disease (Morrison et al., 2007). Thus, researchers have been examining ways to reduce the risk of childhood obesity, thereby reducing the risk of other chronic diseases as they age.

Physical activity is one pathway researchers have targeted as a behavior modification to reduce childhood obesity and childhood MetS. Physical activity is defined as any bodily movement produced by skeletal muscle that results in an increase in energy expenditure above resting levels (Caspersen, Powell, & Christenson, 1985). The current United States Aerobic Physical Activity Guidelines state children should participate in a minimum of 60 minutes a day of moderate to vigorous physical activity (Piercy et al., 2018). An example of a moderate activity is playing doubles tennis, whereas vigorous physical activity is running a race. The guidelines stipulate that three days of the week children should participate in vigorous physical activity. Individuals should make an effort to include muscle and bone strengthening activities three days a week as well. As previously mentioned, the Physical Activity Advisory Committee released a scientific report detailing areas the new guidelines would focus on and areas for future research.

According to the scientific report, more research should examine the role and contribution light intensity activity, alone, or in combination with moderate to vigorous physical activity to health outcomes. Intervention studies should focus on replacing time spent in sedentary behaviors, as well as to test the effect of reducing sedentary behavior on health outcomes in adolescents. In the past wearable monitor technology did not permit the detailed examination of light physical activity, leading to the rationale for the expansion of these specific areas of research. Researchers accept that physical activity provides various health benefits; however, at this time they are unsure of the exact health benefits light physical activity and potential implications increasing light physical activity may have on childhood obesity (Nader, Bradley, Houts, McRitchie, & O'Brien, 2008; Steinberger et al., 2009). A similar relationship with physical activity and MetS, is improved brain function and structure, and insulin sensitivity (Hsu et al., 2011; Ross et al., 2015). Overall physical inactivity is one of many modifiable risk factors for chronic diseases. If researchers can discover more opportunities for physical activity and aid in the development of healthy behaviors during childhood adolescence, it is possible to reduce associated risk factors, such as childhood obesity, which may track into adulthood.

Furthermore, physical activity can provide more than just health benefits (Cote et al., 2013; Ross et al., 2015). Research indicates physical activity can influence academic outcomes as well (Rauner, Walters, Avery, & Wanser, 2013). The current body of literature suggests physical activity participation may positively impact academic engagement, but assuredly does not negatively impact academic engagement, or academic performance, (Erwin et al., 2016; Grieco et al., 2016; Mahar et al., 2006).

Schools and Physical Activity

In 2001, Congress passed a law known as "No Child Left Behind Act" (NCLB). This law required schools to create "challenging" academic standards for English, Math, and Science (Black, 2017; Ryan, 2004). Following this legislation, 2015 Congress passed "Every Student Succeeds Act" (ESSA). Like NCLB, ESSB continued the requirement of "challenging" standards, but tests were restructured to prepare students for college and careers (Black, 2017). Despite making an effort to improve academic standards, the continual attention to testing is a contributing factor an increase in sedentary behavior in children (Bryan, Sims, Hester, & Dunaway, 2013). In Fall 2018, 55 million students were predicted to enroll in elementary and secondary schools (U.S. Department of Education, National Center for Education Statistics, & (CCD), 2017). In schools, most of a traditional day is spent participating in sedentary behaviors (e.g., sitting at desks during class, sitting at lunch, etc.). Lack of physical activity can be detrimental to physical health as well it may have a negative impact on academic performance. Currently, research suggests a positive relationship between physical activity and academic achievement (Ahamed et al., 2007). Likewise, when compared to individuals with low aerobic fitness, individuals with higher aerobic fitness levels have performed better on standardized math and reading tests (Chomitz et al., 2009; Rauner et al., 2013). Despite these findings, school systems are consistently forced to divert attention from extraneous activities (such as recess and physical education) to more sedentary, traditional classroom-based test preparation due to laws such as NCLB and ESSA (Black, 2017; Ryan, 2004).

As a result, researchers have begun examining strategies to incorporate movement into the school day. As part of this effort, the Comprehensive School Physical Activity Plan (CSPAP) was developed. This multi-approach plan encourages school districts to foster more physical activity. The five main components include: physical activity before and after school, physical education, physical activity during school, staff involvement, and family and community engagement. CSPAP has two main goals of providing opportunities for students to meet the physical activity guidelines and provide better knowledge in physical education (SHAPE America., 2018). The current study will focus on the physical activity during school component of CSPAP.

Because school time comprises such a large portion of the day, the school environment provides an excellent opportunity for improving physical activity in children (Mahar et al., 2006). Most children, regardless of race and socioeconomic status, attend public schools (U.S. Department of Education, National Center for Education Statistics, & (CCD), 2016; U.S. Department of Education et al., 2017). Research shows increasing physical activity improves health (Chomitz et al., 2009; Hsu et al., 2011), academic performance and on-task behaviors (Chomitz et al., 2009; Hsu et al., 2011; Mahar et al., 2006). As a result, some researchers and school systems are utilizing several methods to incorporate more movement in classrooms (SHAPE America., 2018).

Movement Incorporation Methods

Movement Incorporation (MI) methods have come about as a means of interweaving physical activity into classrooms. Currently, two main approaches exist for MI: traditional methods and alternative methods. Traditional methods of MI can be further separated into two distinct categories: infusing the activity into an academic lesson and activity breaks. As mentioned previously, physical activity is defined as any bodily movement produced by skeletal muscles that increases energy expenditure above resting levels. Using this definition, researchers are starting to examine alternative MI methods such as fidgeting behaviors. Each method consists of different requirements for the teachers implementing the program, and the general logistical themes of traditional and alternative MI methods are considered here.

Traditional MI Methods

Traditional MI methods can be broken down into two categories. The first category of Traditional MI infuse the movement into an academic lesson, often utilizing prefabricated programs such as “TAKE 10!”, “Physical Activity Across the Curriculum (PAAC)”, “Energizers” and “Active Smarter Kids (ASK)” (Mullender-Wijnsma et al., 2016; Resaland et al., 2016; Webster, Russ, Vazou, Goh, & Erwin, 2015). Infusing physical activity into the curriculum often requires teachers to undergo training on how to implement each specific programs (Bartholomew & Jowers, 2011; Donnelly et al., 2009; Resaland et al., 2016). The TAKE 10! program provides resources to incorporate 10 minute activities into core curriculum lesson with objectives including: Math, Reading, Language Arts, Science, Social Studies, and Nutrition and Health (Stewart, Dennison, Kohl, & Doyle, 2004). The activities in the TAKE 10! program are set up in 10-minute intervals to help the teacher reinforce current curriculum. For example, if a teacher wanted to review language arts, he or she could use a TAKE 10! resource to review the words. The teacher would have the class line up in groups, then explain, as a class, they are going to review language arts, specifically focusing on spelling words. The class would have a relay race to reviews words, where teams of students would take turns racing to the board, writing one letter on the board, the racing back until the word is spelled. The group that spells the word the fastest and correctly wins (Grieco et al., 2016). TAKE 10! has a limited quantity of review lessons a teacher can use. As a result, researchers and teachers have worked to expand infusing physical activity into the lessons. One example of the expansion is Physical Activity Across the Curriculum (PAAC). This program builds upon the foundation of TAKE 10! activities, by training teachers how to incorporate physical activity into an existing lesson (Donnelly et al., 2009). For example, a science teacher who wanted to incorporate movement into her whole lesson, and not just a 10-minute review, could be trained on how to make a lesson on the solar system have more movement. The teacher could set up different stations throughout the classroom and at each station the student would learn about that part of the solar system. Improvements in physical activity, energy expenditure, academic achievement, and on-task behavior have been observed with TAKE 10! (Bartholomew & Jowers, 2011; Donnelly et al., 2009; Grieco et al., 2016; Mahar et al., 2006; Stewart et al., 2004), PAAC (Bartholomew & Jowers, 2011; Donnelly et al., 2009; Grieco et al., 2016; Mahar et al., 2006; Stewart et al., 2004), and other similar programs (Bartholomew & Jowers, 2011; Donnelly et al., 2009; Grieco et al., 2016; Mahar et al., 2006; Stewart et al., 2004). One drawback to infusing physical activity into the classroom lesson, is the requirement of teachers to participate in the implementation of the program. Infusing physical activity into existing curriculum may place an added responsibility upon the teacher if he or she must seek special educational training. A MI technique that is less burdensome on teachers is allowing students to take "activity breaks."

Activity breaks may only require teachers to play a CD or a DVD (Bartholomew & Jowers, 2011; Murtagh, Mulvihill, & Markey, 2013; Whitt-Glover et al., 2011). Examples include "Instant Recess" and "Bizzy Break!". Activity break methods involve 10 to 15-minute physical activity breaks between lessons. Approaches to MI that involve intermissions of activity produce results similar to more scripted, prefabricated programs (Murtagh et al., 2013; Pangrazi, Beighle, Vehige, & Vack, 2003; Whitt-Glover et al., 2011). Facilitation on this method requires teachers to pause instruction time and allow students to participate in physical activity. This potential disruption to the lesson may discourage teachers from incorporating movement into the classroom (Webster et al., 2015). Physical activity is a complex behavior that encompasses all factors that make up movement (Morrow & Freedson, 1994). One factor included in physical activity is energy expenditure. Mechanisms of MI in the classroom continue to improve to better address all aspects of physical activity.

Alternative MI Methods

To better address school time physical inactivity, researchers have begun focusing on alternative methods to incorporating moving in the classroom. This method focuses on fidget like movements. Non-exercise activity thermogenesis, such as restless movements or fidgeting, provide increases in energy expenditure when compared to sedentary behavior (Koepp et al., 2017; Levine et al., 2000). Alternative methods of MI in the classroom often use devices such as under-the-desk apparatuses, stability ball, or standing desks (Fedewa et al., 2015; Koepp et al., 2017). Erwin and colleagues found that the use of stability balls did not significantly provide more physical activity than the use of normal chairs; however, there were some limitations to this study, including a small sample size and physical activity was only measured for two weeks (Erwin et al., 2016). Other studies similar to Erwin 2016, did find the use of stability balls provided improvements in on-task behavior and discipline referrals, and no negative effects on academic performance (Erwin et al., 2016; Fedewa et al., 2015), which in turn can impact academic achievement (Greenwood, 2002). Koepp and colleagues utilized an under-the-desk apparatus in adults and found such devices produced significant increase in energy expenditure (95.7 $\pm$ 12 kcal/hr.) when compared to sitting still in a standard chair 81.2 $\pm$ 18.2 kcal/hr.) (Koepp et al., 2017). While the difference is small, if students were to use this apparatus during the regular day, they would expend an extra 100 kilocalories per day and if the students attended school five days a week, this would translate to an extra 500 Kilocalories per week. These early studies provide a good foundation for understanding fidgeting in classrooms, but more research is needed to examine the impact fidgeting behaviors have on physical activity levels in middle school classrooms. Additionally, research has only begun to investigate the influence of fidget physical activity levels in classrooms on academic success. More research is needed to examine this domain to better understand possible opportunities for implementation of successful interventions.

Conclusions

Increased risk of cardiovascular disease, diabetes and several other chronic diseases exist if childhood obesity and MetS are present (Cook et al., 2008; Cote et al., 2013; Morrison et al., 2007; Ross et al., 2015). Physical activity reduces health risks and provides schools a beneficial factor of improved academic performance and improved academic engagement (Chomitz et al., 2009; Hsu et al., 2011; Nader et al., 2008; Rauner et al., 2013). Nevertheless, schools allocate more time to testing, and less time for physical activity opportunities (Black, 2017; Bryan et al., 2013; Ryan, 2004). MI methods provide tools for teachers to incorporate more physical activity into the classroom.

Traditional MI methods require teachers to have an added responsibility for teachers to participate in activities and receive additional instruction on techniques exists. Alternative MI methods foster movement through fidget like behaviors. Likewise, the relative contribution of this type of activity to overall physical activity levels is not well established in youth. Currently much of the research examines the relationship between movement, academic achievement, and academic engagement within elementary students, and primarily utilizes the traditional methods. Given that sedentary behaviors tend to develop when students are transitioning from elementary to middles school (Biddle, Pearson, Ross, & Braithwaite, 2010; Dowda, Taverno Ross, McIver, Dishman, & Pate, 2017), research examining the effect alternative methods of MI have on middle school physical activity levels and academic engagement is warranted (2018 Physical Activity Guidelines Advisory Committee., 2018; Erwin et al., 2016). Researchers have noted that behavior choices developed during these years determine the individual's health and behavior patterns in adulthood (Park, Scott, Adams, Brindis, & Irwin, 2014).

In an effort to achieve goals set by the United States Department of Health and Human Services, CSPAP, and the national physical activity guidelines, researchers and schools should continue to seek opportunities to include physical activity in classroom settings. Encouraging physical activity in schools can lead to decreased risk of obesity (Hsu et al., 2011; Nader et al., 2008), diabetes (Cook et al., 2008), and MetS as a child and adult (Cruz & Goran, 2004; Morrison et al., 2007). With the increased focus on standardized testing in schools with legislation such as NCLB and ESSA, there is a concern that students are receiving even less physical activity. It may seem adding physical activity will take away from the learning process; however, the current body of literature contradicts this idea. More research is needed to determine if a minimally invasive method of incorporating movement into classrooms can meaningfully increase physical activity while maintaining or improving academic engagement. Thereby, possibly improving academic achievement and the physical health of students.

Minimally invasive, low implementation burden interventions expand the current literature focus, which has been primarily on traditional methods of movement incorporation (e.g. TAKE 10!, Infusing physical activity into the lesson, and activity breaks) and in young children. Minimally invasive or alternative method of movement incorporation such as an under-the-desk band on which students can freely bounce their feet, has not been extensively examined in any age group. Because middle school is a critical time for the development of sedentary behaviors, the present study seeks to determine the impact an alternative method of movement incorporation would have in middle school classrooms.

Therefore, this study had a twofold purpose: firstly, to examine the effect alterative movement incorporation methods, such as fidgeting, have on physical activity levels in middle school students: and secondly, to examine the relationship between fidgeting and academic engagement.

Researchers anticipated there would be a significant increase in physical activity levels, due to the use of an under-the-desk band, when comparing the intervention and control times. Further, it was anticipated the bulk of the increases will be due to an increase in light physical activity. Additionally, researchers propose that a positive relationship would exist between fidgeting behaviors and academic engagement.

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CHAPTER III

METHODOLOGY

Study Design

The study was conducted over a span of 12 weeks during the Fall 2018 semester. Two 6th grade English classes from a southeastern public school district were invited to participate. These classes were selected because teachers expressed an interest in participation. To best address the twofold purpose of this study, each classroom featured a different study design. One classroom served to answer research question one (1): Does the use of an under-the-desk band increase physical activity in a middle school classroom? This classroom will be referred to as the Physical Activity Class. While the second classroom (which will be referred to as the Academic Engagement Class) served to answer research question two (2): Does the use of the under-the-desk band improve academic engagement?

Research question one was addressed using an experimental design with participants serving as their own controls. A total of twenty-two students participated in the physical activity class. The control period lasted for six full school week and two three-day school weeks. Immediately upon completing the control period, under-the-desk bands were placed on the desks of all students participating in the study in this classroom. The intervention period continued for six weeks. In the academic engagement class for research question two, a single subject multiple baselines design was used to assess academic engagement (time on-task). In this classroom, all students were recruited to participate and wear accelerometers. Six students were randomly selected for behavioral observation to review their time on-task or academic engagement. Each of the six students started the intervention under varying baseline conditions as is common in multiple baseline designs to establish control (Mahar et al., 2006). To ensure better control, the order in which the student received the interventions was randomly selected. See Appendix A for a diagram depicting both study designs. All measurements will be detailed in following sections.

Participants

The school district reports 5,078 students are enrolled in grades kindergarten through 12th grade for the 2018-2019 school year; 1,152 of those students are enrolled at the middle school (grades 6-8). The middle school reports a gender break down of 47.4% Female, and 52.6% Male. The racial make up of students is as follows: 68.66% African American; 26.22% Caucasian; 3.47% Asian; 1.39% Hispanic or Latino (Mississippi Department of Education., 2018). Of the two 6th grade English classes that participated in the current study, approximately 25 students were in each class.

Human subjects research was approved by Mississippi State University and the school district. Prior to data collection, researchers obtained parental consent, and assent from students prior to participation. Participants and parents were informed that participation is voluntary, and students may withdraw at any time without any consequence.

Measurements

General Procedures

In both classes, all students were assigned a physical activity monitor, and all students could use the under-the-desk bands regardless of research participation status; however, only data from research participants was used in data analysis. Each day students entered the classroom and collected his or her accelerometer from a bucket. To ensure participants were using the same monitor each day, the monitors were labeled with the participants name

Demographics

Demographic variables were obtained from all participants. At the beginning of data collection participants answered a simple questionnaire (Appendix B) which aimed to gain knowledge about the students age, gender, and ethnicity/race (e.g. how old are you, please select the gender you best identify by.)

Anthropometric measures

Height, body mass, and waist circumference were assessed on two separate occasions (at the beginning and end of the study) according to standard procedure (Malina, 1995). Measures were taken at the beginning and end of the study for the purpose of controlling for growth. To measure standing height and sitting height, researchers used a portable stadiometer (ShorrBoard; Olney, MD). All measurements were taking in duplicate and recorded at the nearest millimeter for body composition assessment. Participants stood erect, without shoes, with head in the Frankfort horizontal plane. Researchers used a digital scale (Tanita, Ironman; Arlington Heights, IL) to measure body mass. Waist circumference was measured to determine central adiposity. A Gulick tape was used to take duplicate measures of waist circumference above the iliac crest to the nearest tenth of a millimeter.

Maturational status can affect body size and various physiological functions. Thus, controlling for maturity is especially important during adolescence, as variability between individuals of the same age can exist. Maturity was determined using maturity offset (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002). Age Peak Height Velocity is a benchmark of maximum growth rate. Gender specific regression equations predict how far an individual is from this maturational milestone. Predictions of how far an individual is from peak height velocity are based on the differential growing in the timing of leg length and sitting height. The procedure is noninvasive and utilizes anthropometric measures, such standing height and sitting height. To estimate the age at peak height velocity maturity offset was used as a co-variable in statistical analysis.

Blood pressure

An automatic blood pressure cuff (Omron, HEM-907XL) was used to measure systolic and diastolic blood pressures (SBP and DBP). Duplicate measures of resting blood pressure were obtained. In an effort to insure resting values are in accordance with current standard procedures, participants sat quietly five minutes prior to blood pressure measurement (Falkner et al., 2004).

Physical activity

Physical activity was assessed using ActiGraph GTX3+ accelerometers (Pensacola, FL), monitors were worn on the ankle on the same side of the individuals dominant hand similar to previous research (Crouter, Oody, & Bassett, 2018; Ekblom, Nyberg, Bak, Ekelund, & Marcus, 2012; Hager et al., 2015). Accelerometers were worn just proximal to the lateral malleolus parallel to the fibula. To ensure consistency, each student used the same monitor for the course of the study, except in the case of a malfunction. Monitors were labeled with students' name and placed in a bucket with lid. Teachers and students were provided verbal and visual instructions on how to properly wear accelerometers (see Appendix C). Visual instructions were placed on both sides of the bucket. At the end of class monitors were placed back in the bucket. On Monday and Wednesday mornings, researchers delivered monitors to the classrooms, and picked the monitors up around 1 o'clock on Tuesday and Friday. Monitors were then downloaded, and reinitialized. On five occasions, the student researcher only picked up monitors on Fridays. Data was analyzed by vector magnitude as raw counts per five seconds. A coefficient of variation (CV) was also calculated for each five second epoch. This was done by examining each five second epoch and all combinations of the surrounding 11 five second epochs. This was carried out until combinations were examined and the lowest CV for twelve possible conditions was used as the CV for that five second epoch. Regression equations were used to determine metabolic equivalents for the vector magnitude and CV (Crouter et al., 2018) . Variables used in data analyses were minutes of spend in sedentary, light, moderate, and vigorous physical activity. As well as energy expenditure. Researchers also determined percentage of class time spent at each activity level.

Academic engagement

Researchers used momentary time sampling with twenty-four second intervals to measure academic engagement, or on-task behavior. This timing interval allowed four second per student. An observer using this timing would code behavior occurring for individual students each time the four second interval ends recording if target behavior occurs (Cooper, Heron, & Heward, 2007). In this study, researchers coded off-task behavior in order to calculate the percentage of academic on-task behavior for analysis. Researchers recorded data using paper and pencil. Each trial resulted in scores based off an average percentage of on-task behavior. On-task behavior was defined as actively engaged in academic material and following directions of teachers. Off-task behavior was defined as being out of seat, doing something other than the assigned task (i.e., talking to or trying to help another student), fidgeting with clothes or materials on his/her desk or body while looking somewhere other than at academic material, laying head down on desk and looking somewhere other than at academic material, or engaging in any other behavior than the academic demand. The operational definition for off-task behavior included inappropriate use of the under-the-desk band (i.e., putting hands on the band or looking under the desk to mess with the band). Off-task behavior does not include proper use of the under-the-desk band (i.e., touching feet or lower legs to band).

Prior to data collection, the primary researcher and three secondary observers received two observation training sessions. The operational definition was adjusted once to add clarity. The primary researcher made behavior observations every Wednesday for 15 minutes. The same secondary observer attended all but two observation periods, in order to obtain interobserver agreement (IOA). On one of the occasions another trained observer attended. On the last trial, only the primary researcher took measurements. The goal for IOA was above 80% agreement. In the event IOA ever fell below 80% for two consecutive weeks, a re-training session was planned. Behavior observation involved six randomly selected students, the order in which he or she received the intervention was decided based off random selection from a hat and then placement into the multiple baseline single subject design.

Data analysis

General data analysis. All data was analyzed using statistical software (SPSS; Version 25). Descriptive statistics for all variables are calculated. To address hypothesis one, Wilcoxon signed ranked tests were used to determine if differences in physical activity occurred for the class participating in the physical activity portion of the study. To address hypothesis two, researchers graphed on-task data for visual analysis. Spearman’s rho were also calculated to determine the relationship between academic engagement and physical activity.

Physical activity data processing. A regression equation (Crouter et al., 2018) was used to determine time and energy expenditure for sedentary, light, moderate, and vigorous physical activity occurring during class period. The regression equation does not determine the difference between sedentary time and non-wear time. As a result, researchers examined everyday of physical activity data. Any days the student had sedentary time above 60 minutes or had a sedentary time significantly different from others in the class were re-analyzed using Actigraph wear time validation software (Troiano, 2007). This time was chosen due to the fact students were in class for a minimum of 74 minutes. Any day in which there was an increase in sedentary time compared to other peers, but upon further examination of all axes and vector magnitudes appeared student may have forgotten put on monitor at the beginning of class were included for analysis. Attendance records were also sought in order to best determine if the student was even present to wear the monitor.

Academic engagement data processing. Academic engagement was graphed for each student, and visual analysis was used for interpreting level, trend, and variability within and between phases. Effect sizes were calculated using the nonoverlap of all pairs (NAP) (Parker & Vannest, 2009). NAP was used to determine the magnitude of academic engagement difference between baseline and intervention periods. NAP is calculated by the number of comparison pairs showing no overlap, divided by the total number of comparisons (Parker & Vannest, 2009). According to Parker and Vannest, values between 0 and 0.65, 0.66 to 0.92, and 0.93 to 1.00 are considered weak, moderate, and large effects, respectively (Parker & Vannest, 2009).

Data management strategy

Collected data was saved in a password protected excel spreadsheet and identifiers were removed for publication. All students were assigned a participant identification number that only researchers with IRB clearance for this study had the identifying data for. Any paper data sheets were digitized, then kept in folders with participant identification numbers and locked in a filing cabinet at 122 McCarthy Gym.

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CHAPTER IV

RESULTS

Demographics

Nine students from the physical activity class were removed for final analysis, six students were removed because the switched to a different class period and had missing data, two more removed due to incomplete data sets, and one student changed school districts. Six students from the academic engagement class were included in final analysis. Resulting in nineteen total participant included for final analysis. Seventeen students reported being right hand dominate, two reported being left hand dominate. Frequencies for biological sex, gender association, known ADHD medication for all participants is presented in Table 1. One student did not answer biological sex, and a separate student did not answer gender association. Table 2 presents racial background for all participants.

Table 1

Sex, Gender, and Known Medication

Variables	N (%)	N (%)
Sex	9 Male (47.4%)	9 Female (47.4%)
Gender Association	9 Male (47.4%)	9 Female (47.4%)
ADHD Medication	0 Known (0%)	19 Unknown (100%)

One student did not feel comfortable completing biological sex. Another student did not feel comfortable answering their gender association.

Table 2

Associated Race Frequencies

Caucasian	African American	Multi-Racial	Other
14 (34.1%)	8 (42.1%)	1 (5.3%)	2 (10.5%)

Frequency (Percentage)

Demographic statistics were calculated for age, height, weight, BMI, maturity offset, waist circumference, systolic blood pressure, and diastolic blood pressure. Results are presented in Table 3. Boys were found to be around the 75th percentile for height, below the 90th percentile for weight, the 85th percentile for BMI, below the 75th percentile for waist circumference, systolic and diastolic blood pressures were both found to be around the 50th percentile. Girls were found to be around the 50th percentile for height, below the 75th percentile for weight and BMI, below the 50th percentile for waist circumference, systolic and diastolic blood pressures were both found to be around the 50th percentile. Maturity offset was found to be 1.15 years away from maturation, which for this age group is average maturation. A few participants were early or late maturation, but the majority were average.

Table 3

Demographics

	Mean	Standard Deviation
Age	12.03 years	0.62 years
Height	152.35 cm	7.29 cm
Weight	46.56 kg	11.77 kg
BMI	19.94 kg · m^{-2}	4.25 kg · m^{-2}
Maturity offset	-1.15 years	1.14 years
Waist circumference	70.12 cm	10.38 cm
Systolic blood pressure	109 mmHg	8.76 mmHg
Diastolic blood pressure	67.64 mmHg	7.70 mmHg

Hypothesis One: Physical Activity

Total time spent at each activity level (sedentary, light, moderate, or vigorous), as well as percentage of class time spend in each level, and total energy expenditure during control and intervention periods is displayed in Table 4. Students included in this analysis were members of classes that lasted 77 minutes (n=13) and 74 minutes (n=6). A typical modified block schedule lasts approximately 75 minutes. Data was non-normative due to limitations with wear compliance. As a result, researchers ran Wilcoxon signed rank tests to determine differences in activity levels between control and intervention periods. Two separate tests were run to examine overall time and percentage of time in each activity level. Wilcoxon signed ranks tests revealed a statistically significant increase in time spent in sedentary during the intervention period, z = - 2.853, $p = 0.004$, with a medium effect size (r = 0.46). The test also revealed a statistically significant decrease in light physical activity time during the intervention period, z = - 3.157, $p = 0.002$, with a large effect size (r = 0.51). No statistical difference in time spent in moderate (z = - 0.501, $p > 0.05$), vigorous physical activity (z = - 1.852, $p > 0.05$), or energy expenditure were found (z = - 0.588, $p > 0.05$). When examining percentage of class time spent at each activity level, similar results were found. Wilcoxon signed ranked tests revealed a statistically significant increase in the percentage of sedentary time (z = - 2.415, p = 0.016, r = 0.39), a significant decrease in the percentage of light (z = - 2.173, p = 0.030, r = 0.35), moderate (z = - 3.340, p = 0.001, r = 0.54), and vigorous(z = - 2.575, p = 0.010, r = 0.42) physical activity time during the intervention period.

Table 4

Activity times, percentage of time, and energy expenditure during control and intervention periods

	Control		Intervention	
	Mean	Standard Deviation	Mean	Standard Deviation
Sedentary Time	20.2 minutes (24.26%)	5.93 minutes (4.96%)	25.55 minutes (33.6%)	9.60 minutes (12.4%)
Light Time	52.18 minutes (69.74%)	12.67 minutes (7.06%)	48.30 minutes (63.3%)	8.63 minutes (11.6%)
Moderate Time	1.95 minutes (5.67%)	0.75 minutes (1.58%)	2.29 minutes (2.99%)	1.30 minutes (1.69%)
Vigorous Time	1.08 minutes (0.22%)	4.31 minutes (0.15%)	0.03 minutes (0.24%)	0.07 minutes (0.09%)
Energy Expenditure	30.83 Kcals	14.37 Kcals	26.91 Kcals	2.46 Kcals

The control period includes all nineteen students. The intervention period includes eighteen students because one student in the academic engagement class remained in control for the entire study. Percentages were determined off of percentage of activity during class period (total time divided by product of days and class time).

Hypothesis Two: Academic Engagement

Data for all participants were graphed for visual analysis (Figure 1). Average academic engagement percentages for each condition are presented in Table 5 along with NAP to measure the effects of the intervention when baseline and intervention were compared. For students 2-5, a weak effect size was found, however student 1 demonstrated a moderate effect size. IOA ranged from 70.6% to 85.8% with a mean of 81.37%. No follow-up training was needed.

Table 5

Mean academic engagement and NAP for each participant for baseline and intervention

	Baseline	Intervention	Effect Size	Standard Error
Student 1	79.83%	75.26%	0.5[c]	0.161
Student 2	91.56%	93.2%	0.629[c]	0.172
Student 3	66.39%	58.55%	0.333[c]	0.154
Student 4	68.72%	74.35%	0.681[b]	0.234
Student 5	59.1%	61.58%	0.333[c]	0.196
Student 6	81.37%			

Note: Student 6 remained in baseline for all trials. Effect size strength was based off work done by Parker &Vannest, 2009

[a] Large effect size

[b] Medium effect size

[c] Small effect size

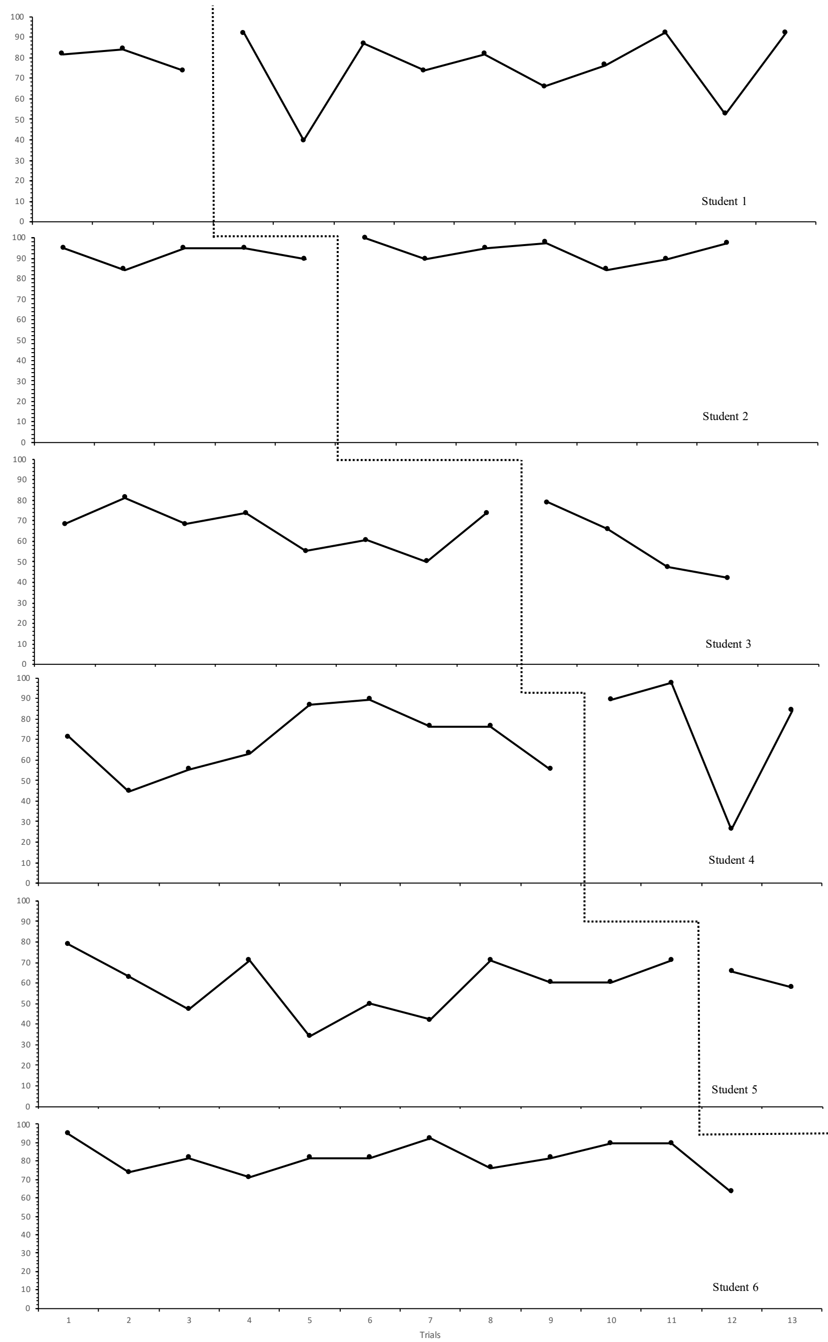

Figure 1. Academic Engagement across baseline and intervention trials

Student 6 remained in baseline throughout all trails to serve as a control. Students 2, 3, and 6 were absent one trial each, resulting in twelve total trails instead of thirteen. The week fall break (which included one late start day and a four-day weekend) fell during the 5th trial for students 1, 3, 4, 5 and the 4th trial for student 6. Nine-week testing took place during the 12th trial for students 1, 3, 4, 5, and the 11th trial for students 2, and 6.

Student 1

Student 1 was the first student to be moved into intervention. There is no clear change in level or trend between intervention (M=75.26%) and baseline (M=79.83%). NAP between baseline and intervention was 0.5, which as previously. State indicated a weak effect size. The intervention data did present a lot of variability between trials.

Student 2

Student 2's data showed a stable pattern throughout baseline (M=91.56%) and intervention (M=93.2%). No change in level and very little variability in data. NAP between baseline and intervention was 0.629, which indicated a weak effect size. The weak effect can be partly attributed to Student 2's baseline academic engagement being relatively stable and at a mean of 91.56%.

Student 3

Student 3's data did not show a change in level. However, there was a slight declining trend when intervention (M=58.55%) was compared to baseline (M=66.39%). NAP between baseline and intervention was 0.333, which indicated a weak effect size. Student 3 presented classroom discipline problems throughout the study. The classroom teacher moved this student to new desks to improve classroom behavior. The disciplinary issues could be a possible explanation to the slight trend decline.

Student 4

Student 4's data indicated a slight level change during the first trial of intervention. Outside of this one incident a clear change in level or trend is not seen in the intervention (M=74.35%) when compared to baseline (M=68.72%). This can be attributed in part by the large variability during the intervention period. NAP between baseline and intervention was 0.681, which indicated a medium effect size.

Student 5

Student 5's academic engagement did not display a change in level or trend from baseline (M=59.1%). to intervention (M=61.85%). NAP between baseline and intervention was 0.333, which indicated a weak effect size.

Student 6

Student 6 remained in baseline throughout the intervention. Baseline mean of academic engagement was 81.37%. The baseline findings for student 6 add further control and evidence to other student's data. Data indicated very little variability and no clear trend. During trial 10, Student 6 was accidentally provided the intervention. This was resolved the following day. Data points surround this one trial are relatively similar in academic engagement.

Physical Activity and Academic Engagement

The relationship between Physical Activity and Academic Engagement was considered for exploratory purposes only. When examining mean physical activity levels with mean percentage of academic engagement during the intervention, no significant relationships were observed for total time spent in sedentary ($r = -0.063$, $p = 0.919$), light ($r = 0.271$, $p = 0.659$), moderate ($r = -0.638$, $p = 0.247$), vigorous ($r = 0.167$, $p = 0.789$) physical activity, or energy expenditure ($r = -0.694$, $p = 0.194$). No significant relationships were found when examining percentage of time spent at activity levels with mean percentage of academic engagement for sedentary ($r = -0.318$, $p = 0.539$), light ($r = -0.345$, $p = 0.503$), moderate ($r = -0.666$, $p = 0.149$), and vigorous ($r = 0.049$, $p = 0.927$). Researchers conducted individual analyses of each week to examine if specific weeks of school played a role in confounding any potential relationship. Spearman's rho revealed a strong positive relationship between academic engagement during session six and vigorous physical activity (r = 0.894, *p* = 0.041, Figure 2), as well as a strong negative relationship between academic engagement during session nine and moderate physical activity (r = -0.900, p = 0.037, Figure 3).

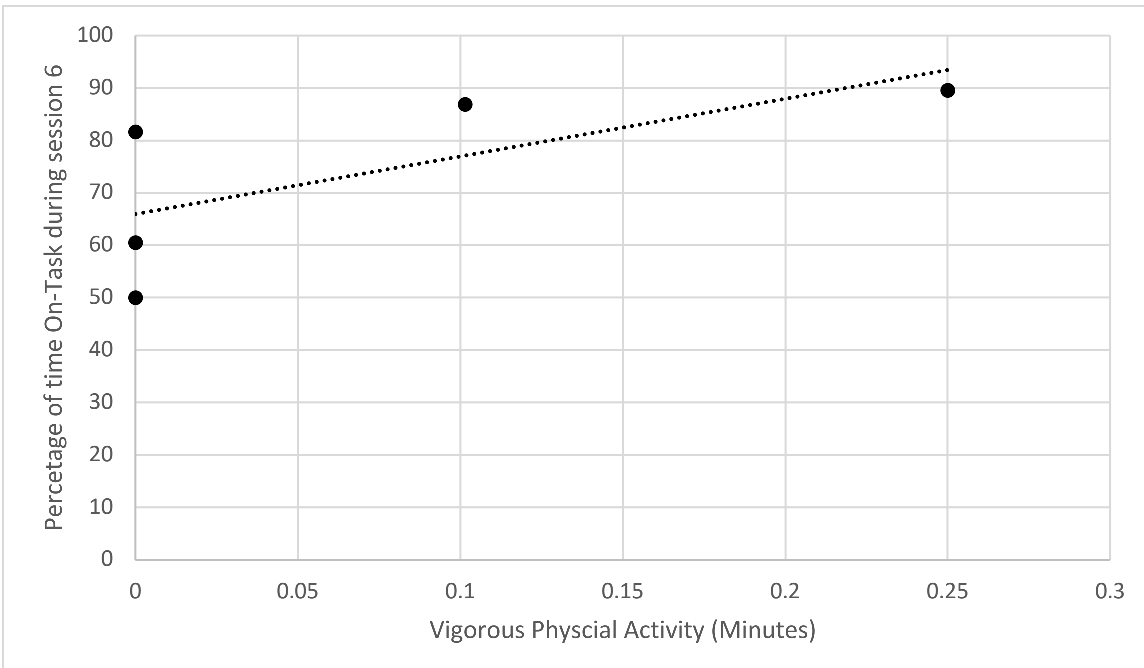

Figure 2. Session six academic engagement and vigorous physical activity

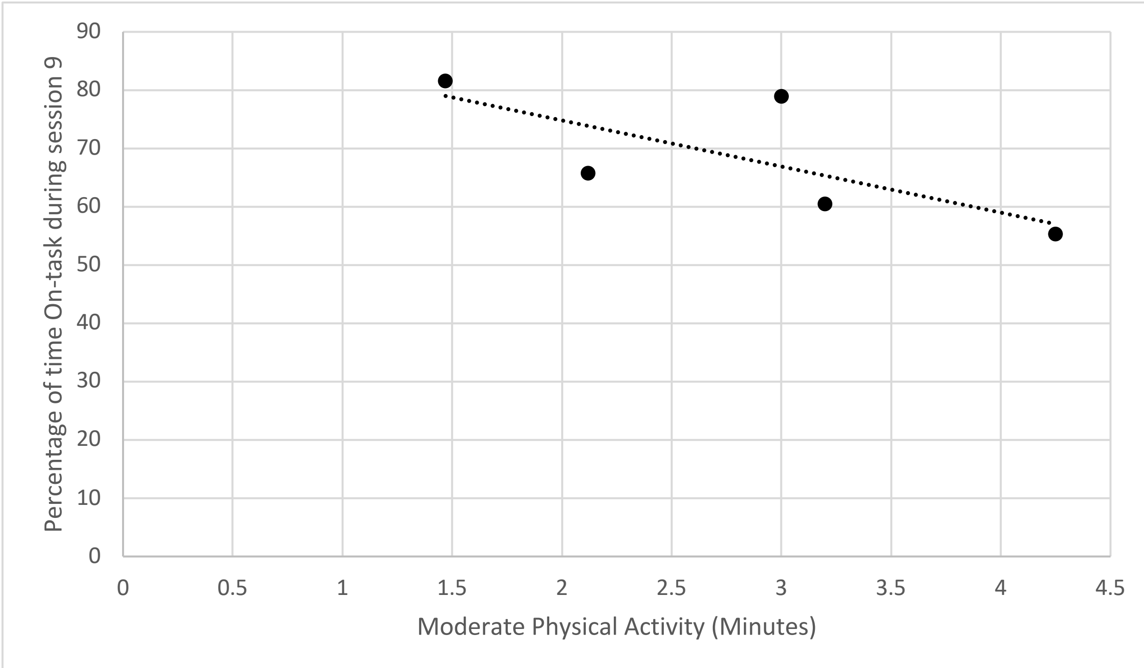

Figure 3. Session nine academic engagement and moderate physical activity

CHAPTER V

DISSCUSSION

The current body of literature indicates incorporating movement into classrooms can provide students the opportunity to be physically active and thereby reducing risks associated with physical inactivity (Donnelly et al., 2009; Grieco, Jowers, & Bartholomew, 2009; Grieco, Jowers, Errisuriz, & Bartholomew, 2016; Martin & Murtagh, 2015). Incorporating movement into the classroom has also shown to improve academic engagement (Erwin, Fedewa, Ahn, & Thornton, 2016; A. Fedewa, Davis, & Ahn, 2015). This study had a twofold purpose, firstly, to examine the effect alterative movement incorporation methods, such as fidgeting, have on physical activity levels in middle school students. Secondly, to examine the relationship between fidgeting and academic engagement. Researchers hypothesized there would be a significant increase in physical activity levels, due to the use of an under-the-desk band, when comparing the intervention and control times. Further, it was anticipated the bulk of the increases would be due to an increase in light physical activity. Additionally, researchers hypothesized a positive relationship between fidgeting behaviors and academic engagement. Results indicated an increase in sedentary time and a decrease in physical activity between the control and intervention periods. Results also indicated the use of an under-the-desk band did not harm or improve academic engagement.

Physical Activity

The results from this study indicated that the use of the under-the-desk band did not improve physical activity levels with statistical significance. In fact, sedentary time increased during the intervention period, while physical activity levels decreased. While these findings are statistically significant, when comparing means and standard deviations the differences do not seem to be meaningfully different. Due to failure to compile with wearing monitors.

At first, the results were surprising to researchers when comparing to similar studies (Erwin et al., 2016; Koepp, Moore, & Levine, 2017; Mahar et al., 2006); however, upon further evaluation researchers concluded inconsistency in wearing monitors during the intervention period highly contributed to the difference in results. In fact, during control, the average days students wore the monitors were 25.53 days; and during the intervention period the students averaged 12.5 days. The 12.5 days average was highly influence by the six students in the academic engagement class who wore their monitors an average of 17 days during intervention, where the physical activity class averaged 8 days. During the last three weeks of intervention, students were preparing for state testing, completing testing, and participating in end of the year activities. These three weeks may have attributed to the difference in wear days.

In the future, researchers should aim to avoid collecting physical activity data around the end of a semester. The current body of research would also benefit from a study of longer duration, which could provide a better idea of physical activity during the intervention period. Issues with attrition should also be addressed.

Academic Engagement

The use of an under-the-desk band did not positively or negatively impact academic engagement when compared to baseline. The results may be attributed to students starting at high levels of academic engagement during baseline and would need to be explored with students who begin with a larger percentage of off-task behavior resulting in less academic engagement. Class disruptions, such as student discipline, substitute teachers, and changing of room set-up, could have negated any improvement in academic engagement and would need to be further explored (Dotterer & Lowe, 2011). Findings the current study support the findings of Ahamed and colleagues who noted school based physical activity does not compromise children's academic performance (Ahamed et al., 2007).

In the academic engagement class, two significant relationships were found between academic engagement and physical activity. During session six, a significant positive relationship was found between vigorous physical activity and academic engagement. This finding could be attributed to two students enrolled in the intervention, one of whom had 100% academic engagement. During session nine a significant negative relationship was found between moderate physical activity and academic engagement. Three students were enrolled in the intervention during session nine, confounding these results. One of the students who had the highest academic engagement had very little moderate activity. The relationship is also impacted by several of the students who were not enrolled in the intervention. Students 4 and 5 had a lot of moderate physical activity, but very little academic engagement when compared to other participants. This finding, along with previous literature (A. L. Fedewa & Erwin, 2011) indicates that the use of under-the-desk bands or similar devices may be beneficial for individuals diagnosed with attention deficit hyperactivity-disorder.

Overall, researchers can conclude that the use of an under-the-desk band has no negative impact on academic engagement, which is consistent with the current body of literature, and yet did not appear to make a positive difference in academic engagement either. The current sample started at a high level of academic engagement, allowing little room for improvement, indicating an area for future study.

Conclusions

The present study found the use of an under-the-desk band did not statistically improve physical activity levels; however, findings also reveal the use of a band does not negatively impact academic engagement.

Strengths

While findings of this study did not support the researcher's hypothesis, several strengths are present. Researchers were able to add to the current body of literature, by examining the impact of alternative methods to movement incorporation in middle school classrooms. The study did feature two very strong study designs. The use of an under-the-desk band does not negatively impact academic engagement, and in a fostered environment some students could see benefits from the use of similar tools. One of the major strengths of the current study is the use of a relatively non-invasive method to foster an active environment while not harming academic engagement. While adherence to wearing the monitors was impacted, the current study did provide a snapshot of how testing periods may impact physical activity levels.

Limitations

The main limitation was adherence to wearing the monitor. Comparing the control and intervention periods are difficult because of the difference in wear days. It was also possible students did not adhere to monitor placement instructions. Controlling this limitation would be difficult without being present every day to assist with monitor placement. One of the key points of this study was to foster an active environment with as little disruption to the daily class.

Another limitation to the current study, was classroom distractions. This is a real world environment, and researchers could only control limitedly. Student discipline issues is a normal issue in the day to day activities in a classroom. While there is the possibility changing desk formations could also lead to class distractions, teachers need to be able to best serve the purpose of class needs.

Future Research

Future research should aim to start as early in school year as possible, in order to avoid testing periods or to compare testing periods versus non-testing periods. A year-around study with an under-the-desk band would be beneficial to examine longer impacts of movement incorporation. While it would be difficult to control, a year-long study could add academic achievement to examine if an increase in academic engagement increases performance. Future studies would also benefit from larger sample sizes, and examining the impact under-the-desk bands have on students with diagnosed attention deficit-hyperactivity disorder who are more likely to engage in inattention and off-task behaviors as a byproduct of their diagnosis. While not an aim of the current study, future research should examine physical activity levels of students throughout the school day, in order to see if students are getting enough physical activity in other areas of the school day. Future research could also benefit from a better adherence to wearing the monitors.

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APPENDIX A

STUDY DESIGN

Proposed study design

Below (Figure A1) is a visual depiction of the proposed study design. During the course of the study, some changes had to be made, as Figure A2 depicts what the final study design looked like.

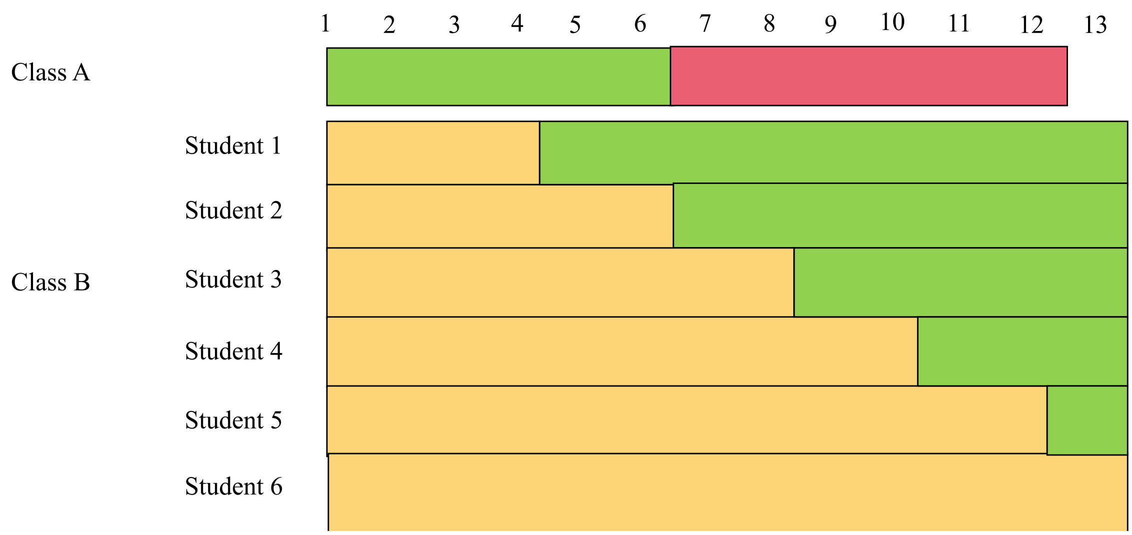

Figure A1. Proposed Study Design

The study design depicted above was the proposed study design. Upon completion of the study, the control period included a two-day beginning phase and fall break. The intervention period included three weeks.

Final Study Design

The following visual depicts final study design. This visual includes the first 3-day week and fall break.

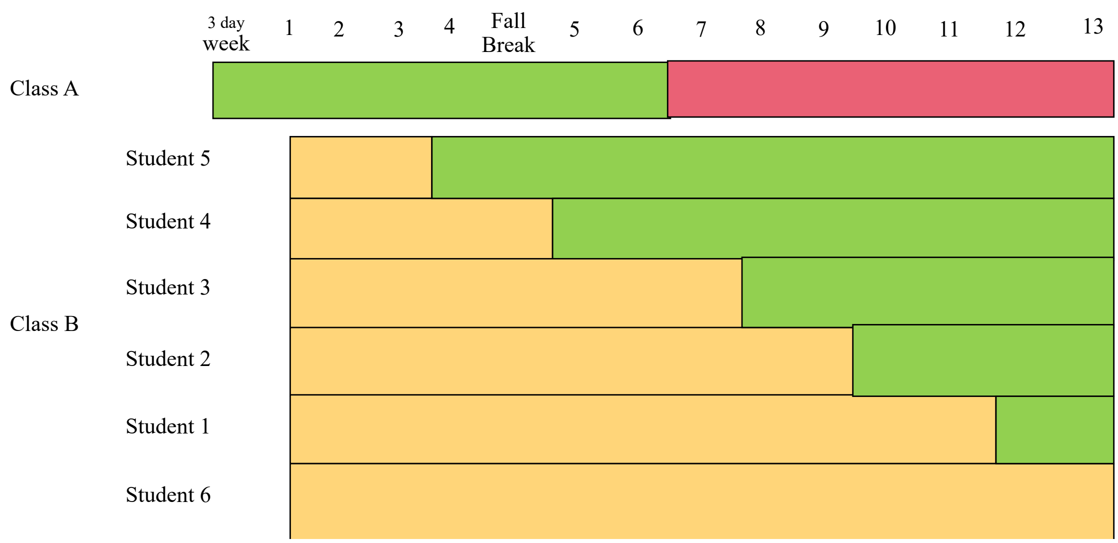

Figure A2. Final Study Design

The study lasted a total of twelve full weeks. Including fall break, the study took place over thirteen weeks. The last three weeks feel during testing preparation, testing, and the end of the semester. Resulting in fewer valid wear days.
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APPENDIX B

QUESTIONNAIRE

Demographic Questionnaire

Directions: The following questionnaire is made up of short answer, fill-in-the blank, and multiple-choice questions about yourself. Please answer all questions to the best of your ability. If you have any questions please feel free to ask.

1. What is your name?
2. When is your birthday?

   Day / Month / Year
3. What is your dominate hand? (Which hand do you write with?)
4. Please list all current medications. If none, write none.
5. What is your biological sex?
   - ☐ Male
   - ☐ Female
6. What is your associated gender?
   - ☐ Male
   - ☐ Female
   - ☐ Transitioning
7. What race do you best associate with?
   - ☐ Caucasian / White
   - ☐ African American
   - ☐ Asian
   - ☐ Hispanic / Latino

☐ Other Please List:

APPENDIX C

INSTRUCTIONS

Visual Instructions

The following figure depicts visual instructions that were placed on the buckets containing monitors. These instructions were explained in detail with the participants before wearing monitors.

1) Find the monitor with your Name on the bottom	2) Put the monitor just above the bony par of your ankle on the same side as your dominate hand (right handed, right ankle)	3) The black cap should face your head and your name should face the floor.	4) Once you have the monitor on properly, try to forget you have it on. At the end of class return your monitor on the box.
	Right Handed = Right Ankle Left Handed = Left Ankle Cap faces up ↑ Name faces down ↓		

Figure C1. Visual Instructions

Above are the visual instructions that were placed on the side of the buckets containing monitors. Researchers walked participants through the instructions and demonstrated how to properly wear monitors