PURPOSEFUL PLAY: THE IMPACT OF INCREASED UNSTRUCTURED PLAY ON FITNESS LEVELS IN SCHOOL-AGED CHILDREN

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Chapter 1: Introduction

Recent history has shown a constant shift in American culture toward a lifestyle driven by sedentary behavior. Sedentary behavior is defined as any behavior requiring an energy expenditure of 1.5 metabolic equivalents or less while in a sitting, laying, or reclining posture (Sedentary Behavior Research Network, 2017). Activities such as watching TV, working on a computer, and playing video games are examples of sedentary behavior that are often routine for American children (Tremblay et al., 2017). Several critical health implications, such as Type II diabetes, obesity, and cardiovascular disease have been linked to sedentary behavior (Rezende et al., 2014). The current norms of physical inactivity and sedentary behavior in the U.S. are critical and persistent health challenges that will continue to create health implications if drastic lifestyle changes are not made (Tremblay et al., 2011).

One of the most pertinent issues linked to increased sedentary time and decreased physical activity in the U.S. is the spike in the nationwide obesity epidemic. Obesity is now the nation's second leading cause of death and is soon expected to be the first (Johnson, 2012). Currently, 18.5% of children are characterized as overweight or obese (Center of Disease Control and Prevention, 2017). Obesity that arises during childhood is often carried into adulthood, which then increases mortality or morbidity rates (Johnson, 2012). The childhood obesity epidemic is among one of the most prevalent issues in pediatric healthcare. The ratio of sedentary time and physical activity time must be reevaluated in American culture, and it should start during childhood in order to preserve health and reverse trends of obesity in the U.S.

Whether enforced or for leisure, sedentary activities are consuming children's time. For instance, the majority of time spent in school requires students to be sedentary. In the

U.S., children attending traditional school systems undergo two hours of content time before granted the opportunity for a break (Rhea & Bauml, 2018). In addition to mandatory sedentary time at school, Guthold and colleagues (2010) reported that one in three children reported spending at least another three hours a day sedentary due to supplementary schoolwork assigned to complete outside of the classroom. An overemphasis on academic success has led to a deficiency in the development of the physical, social and emotional health and wellness in American children (Rhea, 2016). Most public-school systems are limited to either zero or one 20-minute maximum recess break per school day in order to maximize classroom time (Rhea, 2016). Although educators expected an increase in classroom time to lead to improvements in academic performance, no significant improvements in academic success has been found (Ramstetter & Murray, 2017). Instead, an increase in poor emotional and social behavior has emerged, severely damaging the learning environment and limiting students' ability to learn (Rhea, 2016). Education experts from around the world are confirming that a learning environment solely based on cognitive development is producing a broken child; one that does not have the emotional, social, or physical skills to live a healthy lifestyle (Rhea, 2016). However, a new direction of research is evolving which capitalizes the reality that children's bodies and minds are made to move and be creative (Rhea, 2016). Rather than an education system centralized solely around academia, creating a system that includes the physical, emotional, and social aspects would create a more holistic learning environment.

The imbalance in developing the physical, social, and emotional aspects of health in childhood is producing unhealthy children that are becoming unhealthy adults (Johnson, 2012). In other parts of the world, educators have increased physical activity time in schools in order to create a better-balanced learning environment. Physical activity is defined as any force exerted by skeletal muscles that results in energy expenditure above the resting level (Casperson et al., 1985). In Finland, school systems encourage less homework, and more play to allow students the opportunity to develop other life skills (Eco Child's Play, 2018). During each school day, students are allotted 15 minutes of recess for every 45 minutes of classroom time. These unstructured recess breaks serve as a time for students to decompress, release any emotional turmoil by being physically active, practice social skills, and to be kids (Rhea, 2016). These play breaks improve classroom behavior by giving students the chance to burn off energy and play outdoors before getting back to their schoolwork. As a result, Finland has drastically improved their global academic rankings since implementing their current school system that encourages a balance between physical and cognitive development (Rhea & Bauml, 2018). Similar initiatives are beginning in the U.S. in hopes of spreading the advances made by the Finnish education system in creating a holistic learning environment.

One of these initiatives in the U.S. is the LiiNK Project® (Let's inspire innovation 'N Kids); an ongoing research study based off of the Finnish school system (Clark & Rhea, 2017). LiiNK implements four 15-minute, unstructured, outdoor play breaks as well as a character development lesson into each school day at participating schools. The mission of the LiiNK Project is to bridge the gap between academics and the social, emotional and healthy well-being of children (Rhea & Bauml, 2018). LiiNK has matched intervention schools with traditional schools that offer one standard, 20-minute maximum recess period per day, which serves as a control group. Results demonstrate that increased unstructured outdoor play and character development lessons have increased physical activity levels and improved emotional states of children (Clark & Rhea, 2017).

Through the LiiNK Project, students are given the opportunity to be more active through the inclusion of unstructured play breaks without an obligation to participate in physical activity (Rhea & Bauml, 2018). The American Academy of Pediatrics has recognized that outdoor play breaks can aid in counter-balancing sedentary time and can be used as a tool to help children reach the recommended 60 minutes of moderate to vigorous physical activity per day (Ramstetter & Murray, 2017). Initiatives such as the LiiNK Project have spread across the nation in hopes of reestablishing unstructured outdoor play in schools and to create a whole-child learning environment. Previous LiiNK Project research studies have shown improvements in classroom performance, cognitive functioning, classroom behaviors, and social and emotional well-being of LiiNK school children. The current research project aims to build on previous research by exploring health and fitness differences between LiiNK and traditional school students.

In the state of Texas, school districts are required to assess the physical fitness levels of students in third grade and higher using the FitnessGram (Texas Education Agency, 2007). The FitnessGram is a universal and validated testing battery used worldwide to analyze physical fitness levels by evaluating aerobic capacity, body composition, muscular strength and endurance, and flexibility (Plowman & Meredith, 2013). The FitnessGram assesses these aspects of fitness through the inclusion of various fitness tests: the PACER assessment or the one mile walk/run, push-up assessment, curl-up assessment, trunk lift, and a body composition assessment. Within the FitnessGram Reference Guide, experts have provided documentation of reliability and validity measures pertaining to individual assessments within the testing battery (Meredith & Welk, 2007). The FitnessGram is considered the gold standard for physical fitness testing due to its well-established reliability and validity, derived from 35 years' worth of research, evaluation, validation, and enhancement by its Scientific Advisory Board (The Cooper Institute, 2014). The purpose of this study is to compare fitness levels of students in grades 3-5 enrolled at a matched LiiNK school and control school by analyzing student's FitnessGram assessments. Due to the universal recognition for the FitnessGram to assess physical fitness levels, it was deemed an appropriate tool to use for the purpose of this study. This study has the potential to determine if increasing time allotted for unstructured, outdoor play in the school day is an effective measurement in increasing overall health-related fitness levels in school-aged children.

Operational Terms

FitnessGram- a universal, validated test battery that is used to assess physical fitness levels by measuring aerobic capacity, body composition, muscular strength and endurance, as well as flexibility (Plowman & Meredith, 2013).

LiiNK Project® - "Let's inspire innovation 'N Kids" is an ongoing research study influenced by the Finnish educational system with the goal of developing the whole child. LiiNK involves three key strategies; four, 15-minute unstructured, outdoor play breaks, implementing a character development curriculum into daily activities, and the requirement of three, full day teacher/administrator training sessions held annually to prepare for the LiiNK intervention (Clark & Rhea, 2017).

Obesity- having a body mass index (BMI) at or above the 95th percentile of the CDC sex-specific BMI-for-age growth charts (Center of Disease Control and Prevention, 2017).

Sedentary behavior- any behavior requiring an energy expenditure of 1.5 metabolic equivalents or less while in a sitting, laying, or reclining posture (Sedentary Behavior Research Network, 2017).

Recess- regularly scheduled period in the school day for physical activity and unstructured play that is monitored. Students are encouraged to be physically active and engage with their peers in activities of their choice, at all grade levels. (Centers for Disease Control and Prevention, 2019).

Sedentary behavior- any behavior requiring an energy expenditure of 1.5 metabolic equivalents or less while sitting, laying or reclining (SBRN, 2017).

Unstructured play- self-directed and self-controlled without predetermined rules or influence from adults in a safe environment (Gray, 2017; Rhea, 2016)

Assumptions

It is assumed that the students at both schools would understand and follow the instructions of the FitnessGram. It is also assumed that students will perform at the best of their ability. Lastly, it is assumed that the administrators of the assessment follow proper training and scoring in line with state regulations for all assessments.

Limitations

One limitation of this study is that the data collected from the FitnessGram relies heavily on the participation and performance of school-aged children. Another limitation of this study is that it does not assess factors such as motivation levels, determination, or self-efficacy which will impact an individual's willingness to participate in physical activity. This is viewed as a limitation of the study due to the assumption that these internal factors differ significantly between LiiNK and traditional schools. Moving forward, the data collected from this study will not account for any outside involvement of physical activity that could potentially affect physical fitness levels. Another limitation of this study is that data will be collected in two separate settings by separate research teams composed of the physical educators at their respective schools. Prior to the COVID-19 pandemic, data was to be collected by a team of outside, trained researchers to control for any biases or inconsistencies in data collection between schools. Due to the COVID-19 pandemic, many schools are not allowing outside visitors or researchers on campus in order to protect the health and wellness of their students and faculty. While this is a limitation and may impact intra-rater reliability, all physical educators in the state of Texas are required to undergo training prior to administration of the FitnessGram and follow the same guidelines for testing set out by the state.

Delimitations

This study will use the FitnessGram to assess physical fitness levels as research has shown it to be a reliable and valid physical activity assessment. The FitnessGram is utilized as the state-regulated testing battery for public schools in Texas. This study will only investigate schools involved in the LiiNK project compared to pre-existing LiiNK control schools in order to control for recess breaks allotted in the day. This study also delimits to certain grades (3^{rd}-5^{th}).

Variables

The independent variables of the study are the schools which include students grades 3-5 enrolled at the chosen LiiNK school and matched control school. The dependent variable of the study is the FitnessGram scores of students. The FitnessGram is a testing battery which assesses multiple components of physical fitness which are measured independently. The FitnessGram testing battery includes; the PACER (Progressive Aerobic Cardiovascular Endurance Run) test or the one mile walk/run to assess aerobic capacity, the curl-up test to assess abdominal strength and endurance, the push-up test to assess upper body strength and endurance, the trunk lift to assess flexibility, and the body mass index (BMI) test to assess body composition (The Cooper Institute, 2014).

Chapter II: Review of Literature

The following section includes a review of literature regarding the importance of promoting physical health and wellness during childhood development through unstructured play. The American culture has shifted to a lifestyle revolving around cognitive ability and success, often neglecting the importance of physical health and wellness. With an increase in academic pressure, school systems have eliminated or minimized time allotted for physical activity in order to maximize classroom time (Ridgers et al., 2012). Outside of school, children are also spending less time physically active and more time sedentary; where most of their time at home is being spent in activities such as homework, watching television, or playing video games (Rezende et al., 2014). Sedentary behavior is a precursor for obesity, which is now the second highest cause of preventable death in the U.S (CDC, 2014). In order to reverse the trends of sedentary behavior and obesity, exposure to physical activity in childhood must be increased. Physical activity not only promotes physical health, but has known benefits in terms of cognitive functioning, mental wellness, as well as social and emotional development (Clark & Rhea, 2017). As a majority of student's waking hours are spent at school, interventions such as LiiNK have been developed to restore the development of the whole child by increasing the frequency and duration of unstructured physical activity in school (Clark & Rhea, 2017). The following sections will include literature regarding sedentary behavior in childhood, childhood obesity, the importance of physical activity and unstructured play in childhood development, as well as literature regarding the assessment of physical fitness in the school setting.

Sedentary Behavior in Childhood

A sedentary lifestyle has become a widely accepted norm in the U.S., but it has not always been this way. Sedentary behavior, described by the Sedentary Behavior Research Network (SBRN) as any behavior requiring an energy expenditure of 1.5 metabolic equivalents or less while sitting, laying or reclining, can be further classified into two categories; discretionary and nondiscretionary (Tremblay et al., 2017). Nondiscretionary behaviors, such as sitting in school or doing homework, are sedentary behaviors that are typically required and not chosen by the individual for enjoyment (Rezende et al., 2014). Discretionary behaviors, such as watching television or playing video games, are behaviors that are chosen by the individual for enjoyment (Rezende et al., 2014). The development of technology and increase in academic pressures has led Americans to live a life that is more sedentary than ever before, in regards to discretionary and nondiscretionary activities.

An economy once empowered by physical labor has developed into an industrial economy; relying heavily on technology, cognitive performance, and office jobs. This cultural shift has led Americans into living a life so driven by cognitive success, that other aspects of health are suffering, such as their physical and emotional wellbeing. An increased demand on cognitive functioning and disregard for physical or emotional health has not only been reported in the working population, but in children whom are being raised in an environment that prioritizes educational success over their physical or emotional health (Rhea, 2016). The overemphasis on education has created a shadowing effect on the development of other important aspects required for a quality life. The American school system has seen a significant shift towards increased nondiscretionary sedentary behavior in order to maximize the number of minutes required by the school district in subjects such as social studies, mathematics, science, or language arts (Rhea, 2016). On average, students spend two hours in content exposure before getting up to transition to another classroom or take a short-lived break (Rhea & Bauml, 2018).

The U.S. school system continues to prioritize cognitive health over the physical, social and emotional well-being of children. While educators are aiming to improve academic performance by increasing content time, research has shown this relationship to be anything but linear (de Greeff et al., 2018). Realistically, breaks from nondiscretionary sedentary behavior have been found necessary for not only the social and physical development, but cognitive development as well (Rhea, 2016). Children's bodies are designed to move, and confining them to sedentary designed schools is creating emotional turmoil, hindering the development of the whole child and increasing burnout (Rhea, 2016). Interventions worldwide are taking place aiming to reverse nondiscretionary sedentary behavior in schools and increase time spent for physical activity. These interventions have shown improvements in classroom behavior, academic performance, as well as the social and emotional wellbeing of students (Rhea & Bauml, 2018).

The aim of research on sedentary behavior primarily examines discretionary behavior. Technology has had a drastic influence on the discretionary behaviors chosen by children and has led to a more sedentary lifestyle in children than ever before. The days of children engaging in physical activity for leisure have been replaced with sedentary activities such as video games, social media, or watching television (Rezende et al., 2014). A 34-country comparison study found that children averaged more than three hours in discretionary sedentary activities daily outside from their time spent sedentary in school and doing homework (Guthold et al., 2010). Even more concerning, in 2017 researchers found that the average child spends more than seven and a half hours in front of a screen every day (U.S. Department of Health and Human Services, 2017). Another study by Bundy and colleagues (2011), found that children from families with fewer financial resources are more likely to spend time in front of the television instead of being physically active (Bundy et al., 2011). Factors leading to decreased physical activity in families with fewer financial resources are decreased opportunity to join recreational leagues due to financial issues, lack of safety in local neighborhood for play, and as previously mentioned, an increase trend towards technology for leisure time (Bundy et al., 2011). While most children enjoy active outdoor play, parents and caregivers are limiting such activities due to fear of harm or misbehavior (Bundy et al., 2011). Sedentary behavior provides an easier environment for parental control and guidance, which is often the main reason adults limit children's time to play outdoors in an unstructured environment. Excessive time spent in sedentary behaviors can have a negative impact on several health outcomes, yet parents continue to minimize outdoor play due to their impression that they are protecting their children from the possibility of harm or injury (Rezende et al., 2014).

Even with ample evidence portraying the negative impacts of sedentary behavior in childhood, trends towards increasing sedentary behavior are still rising, both in and out of the school setting (Ramstetter & Murray, 2017). Sedentary behavior has been linked to several negative health outcomes, such as increased risk of becoming overweight or obese, mental health disorders, and social development issues (Bundy et al., 2011). Also, the increase demand on academic success and decreased outdoor play has been associated with higher levels of stress and poorer mental health in school-aged children (Bundy et al., 2011). Sedentary behavior and physical inactivity are persistent and detrimental public health challenges that must be addressed, especially in the pediatric population (Rezende et al., 2014). Interventions must take place that work on reversing the trends of sedentary behavior and developing the whole child in order to correct current health implications in the U.S. (Clark & Rhea, 2017).

Childhood Obesity

With the rise in sedentary behaviors and physical inactivity starting at an early age, childhood obesity is another growing concern in the U.S. Currently, 18.5% of children and adolescents are either obese or overweight (CDC, 2014). Health consequences related to childhood obesity include the development of adulthood obesity, cardiovascular diseases, diabetes, and increased morbidity and mortality rates (Papas et al., 2016). Obesity is now the second highest cause of preventable death of Americans, with a sedentary lifestyle being a precursor for the disease (CDC, 2017). In spite of the increasing awareness of the consequences of childhood overweight and obesity, the prevalence remains high in many westernized countries (Bundy et al., 2011), as it is expected to soon become the leading cause of preventable death in the U.S. (CDC, 2014).

In addition to impaired physical health, obesity has also been linked to decreased academic performance. While evidence regarding weight status and academic performance is not conclusive, recent studies have shown an inverse association between obesity and academic performance of students (Sardinha et al., 2014). More specifically, Sardinha and colleagues investigated the relationship between weight status, cardiorespiratory fitness, and academic performance among seventh grade students. This study found that weight status and cardiorespiratory fitness were independently and combined related to academic achievement, where normal weight students were 3.72 times as likely to have high academic achievement in comparison to obese students. Psychological factors, including lower self-esteem and body image issues in obese students, are other considered variables that could lead to behavior problems affecting one's academic performance.

If weight status and cardiorespiratory fitness are related to academic success, policymakers and society should recognize the consequences of childhood obesity and take action in reversing these trends. In the U.S., 95% of children aged 5 to 18 years are currently enrolled in school (Papas et al., 2016). The normal school day accounts for a substantial portion of students' waking hours, making school the ideal setting to take action in reversing trends of obesity (Ridgers et al., 2012). Although it seems to be a simple solution, school systems are coming under increasing scrutiny to do it all; improve academic performance and decrease time spent in sedentary activities (i.e. classroom time) to aid in lowering the nation's childhood overweight and obesity rates (Papas et al., 2016). The American Academy of Pediatrics (AAP) policy advocates that participating in 60 minutes of moderate to vigorous activity per day can lower risk of obesity, and that even minor movement during recess can help counterbalance sedentary time at school and lower children's risk of obesity (Ramstetter & Murray, 2017). Despite the profound evidence supporting this claim, school systems are still being enforced to increase classroom time and decrease recess time in order to meet academic standards. To counteract this trend, programs that aim to decrease sedentary behavior and increase physical activity in schools are beginning across the country to lower obesity rates in American children (Bundy et al., 2011).

The Importance of Physical Activity in Childhood

In order to reverse the trends of sedentary behavior and obesity in future generations, children need to lead more active lifestyles. Reed et al. (2013) states the importance of examining the trends of young individual's physical activity habits, as these often become habitual through adulthood, indicating potential exposure to future health implications. Physical activity can take many forms. It can be seen in structural activities such as sports, leisure activities such as walking, or in unstructured play such as recess (Baranowski et al., 1992). Moreover, physical activity can be modified in terms of intensity, duration, pattern of intensity by duration, and muscle groups incorporated (Baranowski et al., 1992). Regular physical activity can improve individual's health-related physical fitness (HRPF), defined as a state involving the ability to achieve daily activities with vigor and demonstrate qualities and capacities that are associated with low risk of premature development of hypokinetic diseases (Pate, 1988). Unfortunately, HRPF is a declining characteristic in American culture due to the rising levels of physical inactivity and sedentary behavior.

The health benefits of living a physically active life during childhood are well known (Guthold et al., 2010; Ramstetter & Murray, 2017; Sardinha et al., 2014). The most obvious and commonly studied benefits of physical activity are those regarding physical health and wellness. Regular physical activity is associated with a healthier life, including decreased risk of obesity, heart disease as well as type II diabetes (Guthold et al., 2010). Other physical benefits to consider of lifelong fitness are the biological outcomes, such as improved cardiovascular health, increased bone mineral density and decreased arterial stiffness (Sardinha et al., 2014). Physical activity in childhood has also been associated with improved motor functioning skills, including fine motor skills and gross motor skills (Lubans et al., 2010). These skills include improvements in locomotor functioning, such as running or skipping, manipulative object control, such as catching and throwing, as well as stability, such as balancing and turning. In addition, physical activity improves an individual's control and coordination as well as spatial-temporal ability, or ability to comprehend where you are in space and time. While profound research has shown the physical health benefits and significance of increasing childhood physical activity, American culture continues to lead down a path of sedentary lifestyles, training future generations to become sedentary too.

The decrease of physical activity time in schools is primarily due to the increase of academic pressures, yet physical activity has been linked to improvements in academic success in students (Ridgers et al., 2012). Physical activity has also been associated with improvements in behavioral and mental health, encouraging the development of the whole child (Clark & Rhea, 2017). Regular physical activity has shown to improve emotional wellbeing, academic performance, social maturation, mental health outcomes and student's ability to stay on task (Guthold et al., 2010; Ramstetter & Murray, 2017; Sardinha et al., 2014).

Moving forward, cardiorespiratory fitness has shown positive effects on cognition and increased brain plasticity (Sardinha et al., 2014). Improved brain plasticity has been associated with superior cognitive health and improved cognitive abilities, improved memory, as well as larger brain structures portraying elevated capability (Sardinha et al., 2014). Physical activity and fitness stimulate neural development, increases density of neural synapses, strengthens neuronal signaling capability, and improves attention and memory capability (Sardinha et al., 2014). Physical activity is beneficial to student's cognitive health and academic success, making it a promising intervention strategy to improving student's performance in the classroom.

In the American school system, students spend a significant amount of their wakeful hours at school, where they are sedentary most of the day during content time (Ridgers et al., 2012). For instance, only six states in the U.S. require physical education in kindergarten-grade 12 (U.S. Department of Health and Human Services, 2017). In addition, a majority of school systems in the U.S. are being limited to either one or zero daily recesses (Rhea, 2016). Recess and physical education are both necessary methods to promote physical activity in school, providing structured and unstructured experiences (Ramstetter & Murray, 2017). Physical education serves as an academic discipline, whereas recess allows children to be active in activities of their choice (Ramstetter & Murray, 2017). A majority of young people's physical activity experiences come from those gained through the school setting, and their perceived enjoyment often determines if they continue to participate in physical activity recreationally in adulthood (Reed et al., 2013). Despite the CDC recommendation for youth to engage in 60 minutes of physical activity a day (2019), most school systems are hindering a children's ability to achieve this goal through limited time allotted for physical activity during school hours. The U.S. Department of Health and Human Services (2017) found that only 1 in 3 children are meeting these recommendations in the U.S. while Guthold and colleagues (2010) found that only 23.8% of boys and 15.4% of girls are meeting physical activity recommendations worldwide. Outside of the school day, children are limited to physical activity at the discretion of their parents/guardians. Since most school-aged children are failing to meet physical activity recommendations and guidelines, school-based interventions that increase opportunities for physical activity are ideal in reversing the trends of childhood physical inactivity and preserving the health and wellness of future generations (Sardinha et al., 2014).

While the benefits of physical activity in terms of physical health and wellness, classroom behavior, cognitive functioning, and mental health are well known, the U.S. is still trending towards reducing the frequency and duration of time allotted for physical activity in the school setting (Ridgers et al., 2012). Findings have repeatedly reinforced the need for more physical activity opportunities in school for the overall health and wellness of students (Sardinha et al., 2014). Thus, it is appropriate to establish physical activity intervention programs in the school systems that provide positive physical activity experiences in order to reverse the trends of sedentary behavior and physical inactivity.

Unstructured Play

Currently, a majority of children's physical activity time is in structured settings such as sports or physical education classes. Unstructured play, self-directed and self-controlled (Gray, 2017; Rhea, 2016) has decreased significantly in recent years in the school and home settings (Bishop, 2013). From 1981 to 1997, free play decreased by 25% in the U.S. (Hofferth & Sandburg, 2001). During the same time period, children aged 3-11 years reduced time spent in free play by 12 hours a week (Murphy, 2005). In 2005, Louv found that children in the U.S. spend less than 30 minutes a week outside in unstructured play. Many factors are responsible for the decrease in unstructured play, including increased pressure for academic performance, increased structured activities such as sports, as well as increase technology use for leisure play (Bishop, 2013; Ridgers et al., 2012). Unstructured play is a neglected teaching tool which offers a child unique developmental benefits which should be offered in the school setting and encouraged at home.

Play is an essential tool in the proper development of children beginning at an early age (Milteer & Ginsburg, 2012). Outside of school, children's exposure to outdoor, unstructured play is limited. Many factors can play a role in children's limited exposure to outdoor play, such as lack of parental control, poverty, and increased use of technology. One troubling factor leading to the decrease in play is the lack of knowledge of how to play in an unstructured setting. Unstructured play is now so uncommon that children often don’t know how to play without instruction or equipment (Rhea, 2016). This is largely due to the increase of technology, which has led to more children engaging in solitary and sedentary behavior such as video games or scrolling through social media as opposed to engaging in unstructured, outdoor play (Bishop, 2013). The lack of parks in local neighborhoods is another factor leading to the decrease in free play, as only one in five homes have a park within half a mile (U.S. Department of Health and Human Services, 2017). Additionally, parental control has a large effect on a child’s ability to participate in unstructured play. Parents often are limited in time available to take their children outdoors to play during daylight hours due to the majority of daylight hours being spent at school or work (Ridgers et al., 2012). In other cases, parents choose to keep their children indoors due to safety reasons, especially families who live in poverty (Milteer & Ginsburg, 2012). A majority of parents who do encourage physical activity enroll their children in structured play, such as sports (Bishop, 2013). While all physical activity promotes improvements of health and wellness, only unstructured play offers benefits that encourage creativity and spontaneous activity for the sheer joy of having fun (Ramstetter & Murray, 2017).

Recess, defined by the CDC as regularly scheduled periods within the elementary school day for unstructured physical activity and play, serves a vital role in reversing sedentary behavior and obesity in childhood (Ramstetter & Murray, 2017). Recess might provide the greatest opportunity for children to engage in physical activity (Ridgers et al., 2012). While not all children participate in vigorous activity during recess, even minor movement during recess can help counterbalance sedentary time and serve as an opportunity for children to reach the recommended 60 minutes of physical activity per day (Ramstetter & Murray, 2017). In addition, unstructured outdoor play has been associated with improved long-term physical activity adherence rates, reductions in perceived exertion, as well as increased enjoyment and satisfaction. Even exercise of light intensity during recess breaks offer physical benefits and significantly increase exercise enjoyment and satisfaction. In addition, even short engagements in nature have shown to be beneficial for mental health as well as exercise enjoyment and satisfaction (Reed et al., 2013). These factors could potentially lead to an increase in motivation to participate in physical activity, decreasing the time spent sedentary, therefore decreasing the risk of obesity, cardiovascular disease, type II diabetes, and other health implications associated with an inactive lifestyle (Papas et al., 2016). Despite the benefits of recess in regards of physical health and wellness, recent trends in the U.S. have reduced the frequency and duration of recess in school (Ridgers et al., 2012).

Recess has been eliminated or minimized in schools nationwide to maximize classroom time and avoid behavioral issues that could arise (Ramstetter & Murray, 2017). Yet, an Australian study found that when children played with unstructured materials, reports of bullying and fighting were nearly non-existent (Bundy et al., 2011). In addition, students are more attentive and better able to perform cognitively after recess (Ramstetter & Murray, 2017). Contrary to current practice, optimal cognitive functioning requires a period of interruption after a period of concentrated instruction (Ramstetter & Murray, 2017). These interruptions are best served in the form of unstructured breaks that allow children time to decompress, rather than shifting from one cognitive task to the next (Ramstetter & Murray, 2017). Recess represents a time for students to rest from cognitive tasks, imagine, socialize, and move; as children's body are designed to move (Ramstetter & Murray, 2017; Rhea, 2016). Evidence has also linked outdoor exposure to improvements in mental well-being of children, improved cognitive functioning and concentration, as well as reduced psychological stress (Reed et al., 2013). In addition, recess also serves as an opportunity for children to develop and practice valuable social skills in a different environment than the classroom, such as cooperation, problem solving, negotiation, as well as other fundamental skills that become lifelong tools (Ramstetter & Murray, 2017). Recess has been deemed a necessary aspect to optimize a child's physical, cognitive, emotional, and social development (Ramstetter & Murray, 2017).

Based on these findings, educational leaders should not only work towards reversing the trend of decreasing recess in school but should increase the duration and frequency of recess in schools (Ramstetter & Murray, 2017). Providing recess at regular intervals will optimize children's ability to regain their focus before instruction continues, improving academic performance and ensuring proper, whole child development (Ramstetter & Murray, 2017). Several interventions have begun globally that aim at providing a whole child development through increasing time allotted for recess in school systems (Ramstetter & Murray, 2017). Organizations, such as the CDC and AAP, are working together to educate parents, teachers, and policymakers on the benefits and need for unstructured play for proper childhood development, both inside and outside of the school setting (Ramstetter & Murray, 2017).

LiiNK- Lets Inspire Innovation N' Kids

Interventions, such as LiiNK, are working towards decreasing sedentary behavior and physical inactivity in schools (Rhea & Bauml, 2018). LiiNK is an ongoing research study inspired by the Finnish school system, which goal is to improve the whole child development in U.S. school systems (Clark & Rhea, 2017). LiiNK's belief is that academics without play will produce a broken child; one who is detached from themselves and others (Rhea, 2016). Through the introduction of a daily character development course and regular recess intervals, LiiNK's mission is to bridge the gap between academics and the development of children's physical, social and emotional wellbeing (Rhea & Bauml, 2018). Students involved in LiiNK receive four, 15-minute unstructured play breaks, accounting for a total of 30 minutes of unstructured play before and after lunch (Rhea, 2016). The project also includes three days of annual training for teachers and administrators, in order to ensure proper functioning of the system (Clark & Rhea, 2017).

In five years of data collection, LiiNK has grown from the involvement of two private schools with a population of 185 students, to the involvement of 38 schools in nine school districts, with a population of over 9,000 students (Rhea, 2019). Through the intervention, students have shown a drastic decrease in their off-task behaviors in the classroom, such as fidgeting, self-talk, staring into space or moving around the room (Rhea & Bauml, 2018). Furthermore, students enrolled at LiiNK schools experienced a 30% decrease in off-task behaviors over the school year, whereas non-LiiNK schools only reported a 2% decrease in classroom off-task behaviors (Rhea & Bauml, 2018). Also, students at LiiNK schools were able to use less listening energy throughout the day, showing improvements in cognitive functioning (Rhea & Bauml, 2018). Implicating multiple recesses and a character development course has improved the mood and emotional states of students (Clark & Rhea, 2017).

Additionally, children enrolled at LiiNK schools took significantly more steps than students enrolled in traditional schools, with a daily difference of about 400 steps, portraying a decrease of sedentary behavior (Clark & Rhea, 2017; Farbo et al., 2020). BMI scores of LiiNK children in comparison to non-LiiNK children have indicated a 5% decrease in BMI scores of LiiNK students and a 6% increase in BMI scores of traditional students (Rhea & Bauml, 2018). While data has been collected regarding the physical activity levels of LiiNK children, the use of BMI and pedometers offer limitations in reliability, and researchers recommend that future research involve a more reliable source to measure physical activity levels (Rhea & Bauml, 2018).

The FitnessGram Assessment

A testing battery used universally in research and practical settings to assess grade school children's physical activity levels is the FitnessGram. The Scientific Advisory Board for the FitnessGram consists of ten experts in the field of physical activity, education, kinesiology, and relating backgrounds that have come together to provide their expertise and expand research in regard to the FitnessGram (The Cooper Institute, 2014). The FitnessGram is the national test for the Presidential Youth Fitness Program and is the most trusted and widely used fitness assessment worldwide (The Cooper Institute, 2014). The FitnessGram battery is considered to be the most psychometrically sound field-based fitness assessment available for children (Meredith & Welk, 2007; Plowman et al., 2006). The FitnessGram assesses five aspects of health-related fitness; aerobic capacity, muscular strength and endurance, flexibility, as well as body composition (The Cooper Institute, 2014). The FitnessGram consists of the following assessments: The PACER test or one mile walk/run, curl-up assessment, push-up assessment, trunk lift, as well as a body composition assessment, each which will be discussed in detail in the following chapter. With the inclusion of these various assessments, each which targets a different component of health and fitness, researchers have concluded that the FitnessGram is a valid and reliable health and fitness testing battery.

Therefore, the research question asked was if differences in fitness levels exist by school, gender, and grade between LiiNK and traditional schools. It is hypothesized that: H1) LiiNK students will perform better on all components of the FitnessGram, H2) LiiNK male students will demonstrate better fitness levels than LiiNK females and all control school students, and H3) no difference in fitness levels will exist by grade at LiiNK or control school.

Chapter III: Methodology

Participants

While LiiNK is currently active in 38 schools, the present study's population only included students from one LiiNK intervention school (N= 177) and one control school (N= 290) in grades 3-5. The two schools chosen are geographically close and contain demographically similar populations. Participants were matched by gender and demographics as closely as possible to a student at the control school of the same grade level.

Instrumentation

FitnessGram. This instrument assesses health-related fitness levels of students (Plowman & Meredith, 2013). This tool measures students' overall fitness by assessing students' performance through five fitness components, which then places students in healthy fitness zones (HFZ); healthy/fit, needs improvement, and needs improvement/health risk. In 2010, experts tested the large-scale quality (validity and reliability) of FitnessGram testing by assessing four testing administration scenarios across the state of Texas. In this study, over 1,000 students were tested on two occasions in the presence of teachers and/or expert test administrators. The study provided data that portrayed relatively high reliability during teacher/teacher administration, with percent agreeance ranging from.74 for assessment of the push up to .97 for BMI assessments. Validity was assessed by comparing teacher and trained teachers to expert testers, with percent agreeance ranging from .64 to 1.00 (Morrow, Martin & Jackson, 2010). Measurements of reliability and validity for individual assessments within the FitnessGram battery are discussed below.

Aerobic Capacity Assessments. The Progressive Aerobic Cardiovascular Endurance Run, or the PACER, is an instrument used to measure an individual's VO_2 max, which is a measurement of the maximum rate of oxygen that can be taken up and utilized by the body during exercise. The concurrent validity of the PACER test has been represented as relatively strong, portraying validity coefficients of .65 in a study done by Mahar et. al in 2006, .76 for a study completed by Ruiz et al. in 2008, and .75 by Mahar et. al in 2011. Experts have found relatively reliable data in regard to the PACER test, portraying an intraclass reliability coefficient ranging from .64 to .93 (Plowman & Meredith, 2013).

Moving forward, the one-mile walk/run is another measurement used by the FitnessGram to assess students' aerobic capacity by calculating their VO_2 max. For studies including youth 1-1.5 miles or 9-12 minutes, researchers have found validity coefficients ranging from .60 to .80 (Plowman & Meredith, 2013). The FitnessGram has recently shifted to a system that calculates student's VO_2 max during the PACER or one mile walk/run assessments. While standards for both tests are designed to estimate VO_2 max, differences in the nature of the assessments and means through which they are converted to estimate VO_2 max, may not always yield the same classification of fitness as the other assessments (Plowman & Meredith, 2013). Thus, it is important to use caution when comparing VO_2 max results between different assessments.

Muscular Strength and Endurance Assessments. Abdominal strength and endurance are assessed during the curl-up assessment (The Cooper Institute, 2014). The curl-up test has been determined to possess logical validity as a test of abdominal strength and endurance, which is supported on the basis of anatomical and biomechanical analyses (Plowman & Meredith, 2013). Data from Patterson and colleagues (2001) found a reliability factor of .89 and .86 for boys and girls aged 10-12 years old.

The FitnessGram recommended test for upper body strength and endurance is the 90-degree pushup. The 90-degree pushup is considered to possess logical validity, yet it is does not have interchangeable validity between secondary tests that are also intended to measure upper body strength and endurance, such as chin-ups or modified pushups (Plowman & Meredith, 2013). Research has found the 90-degree pushup to be a reliable assessment for school-aged children, with correlation values of .64 to .99 being deemed acceptable for the population (Plowman & Meredith, 2013).

Flexibility Assessment. *Trunk*-extensor strength and flexibility is measured through the assessment of the trunk-lift. Criterion for inclusion of the trunk-lift is due to the high level of lower back pain found in the general population. The trunk-lift test is completed by instructing the participant to lay down in the prone position and lift their chin off the ground as far as they can without using their hands as leverage. The tester then measures the distance between the ground and the participant's chin. The trunk-lift has been shown to be relatively reliable, where four studies assessing the test-retest reliability found intraclass correlations of .54, .73, .98, and .99 (Plowman & Meredith, 2013). In terms of reliability in elementary school students, additional data is still needed. In 2006, Hannibal found correlation values for criterion validity to be .82 and .62 and reliability correlation values of .996 and .99 when comparing different versions of the trunk-lift (Plowman & Meredith, 2013).

Body Composition Assessment. Although researchers suggest bioelectrical impedance analysis (BIA) or skin fold measurements to assess body composition, the FitnessGram offers BMI as an alternative due to lack of training or equipment to conduct the other measurements (Plowman & Meredith, 2013). BMI is calculated only using students' age, height, and weight, not differentiating fat mass from healthy mass. BMI is fairly well correlated with percent body fat and does yield useful information to estimate students' body composition.

Procedures

Prior to data collection, IRB approval was confirmed. Parental consent was obtained at control and intervention schools. FitnessGram is a state mandated test and data was only acquired in students who provided consent. Schools sent de-identified data to the LiiNK Project via an excel spreadsheet. The FitnessGram was completed during students' regular physical education class. Data was collected by physical education teachers who were properly trained to instruct the FitnessGram.

Aerobic Capacity Assessments. In this study, each school used a different measure to assess aerobic capacity. The intervention school utilized the one mile run to measure aerobic capacity whereas the control school utilized the 20-meter PACER. Validated and reliable formulas which calculate students' VO_2 max allowed researchers to be able to compare aerobic capacity despite different testing measurements. In terms of the one-mile walk/run test, students' objective was to complete the mile as fast as possible. Once the student finished the one-mile assessment, their time to completion, age, gender, and body mass index were used to determine their aerobic capacity.

In order to conduct the PACER assessment, data collectors provided an area in which students could adequately perform a-20 meter shuttle run. An audio was played aloud that explained the assessment in full before proceeding to the exam. The audio provided music that increased in speed to indicate the increase in pace students must maintain (Plowman & Meredith, 2013). The participant continued until they completed the PACER or could no longer keep up with the increasing pace. In the instance where a participant did not reach the line before the beep, they were to stop where they were and begin running towards the opposite line. Once a participant missed two beeps, their test was complete and they were instructed to stop (The Cooper Institute, 2014). The examiner records the number of completed repetitions on the data collection sheet provided. An equation is then used to convert PACER laps into a comparable one-mile run time, which is then used to predict students' VO_2 max.

Muscular Strength and Endurance Assessments. To perform the curl up assessment, participants were instructed to lie on their back with their knees bent at an angle of approximately 140 degrees (Cleveland, et al., 2016). Participants were instructed to keep their feet flat on the floor and shoulder-width apart, and their arms parallel to their trunk with palms maintaining contact with the ground (Cleveland et al., 2016). A testing strip was placed perpendicular to the participants body close to their feet. Participants were informed that for the curl up to count as a repetition, their fingers must cross the line while remaining in contact with the ground (Cleveland et al., 2016). An audio played aloud preceding the exam providing directions, then provided a cadence during the exam that students must keep for the repetition to count. The curl-up exercise was completed at a cadence of twenty repetitions per minute, until participants could no longer continue. Examiners recorded the number of repetitions completed on the provided data collection sheet.

For the 90-degree pushup assessment, students were instructed to lie on their stomach. An audio recording was played explaining the purpose of the exam before preceding into the assessment, which provided a cadence students must uphold for their repetitions to count. The test was completed at a cadence of one repetition for every three seconds until fatigue (Plowman & Meredith, 2013). In order for a repetition to be considered complete, participants had to reach 90 degrees of elbow flexion and maintain cadence with the audio recording. Examiners recorded the number of repetitions completed on the data collection sheet provided.

Flexibility Assessments. The trunk-lift assessment required students to lie prone with their arms beside their body. Students were instructed to lift their chin off the ground as far as they could without using their hands as leverage. The examiner measured the distance, in inches, between the ground and the participant's chin. Two trials were allowed, and their best score was recorded by the examiner on the data collection sheet provided.

Body Composition Assessment. Test administrators were asked to collect students' height, weight, and age to calculate BMI.

Data Analysis

At the conclusion of testing, descriptive statistics were used to analyze the breakdown of participants in terms of gender, age, and grade level in the matched control and intervention groups. To analyze performance, a MANOVA was used to determine the differences of the independent variables of school type, gender, and grade, with the dependent variables being the sub-scores of the FitnessGram. Individual ANOVAs were then ran to assess school type, gender and grade differences within each fitness component. Researchers chose to compare mean scores of individual assessments rather than use FitnessGram HFZ placements.

Chapter IV: Results

The results from this study represent the fitness levels of 3rd, 4th, and 5th grade students in two Texas public elementary schools (one intervention and one control school). The intervention school students received four 15-minute unstructured, outdoor play breaks daily whereas the control school received one traditional 15-20 minute recess break per day. The purpose of the current study was to investigate the effectiveness of a multiple recess school intervention on fitness in school-aged children by comparing FitnessGram results.

Descriptive Statistics

This study included 3rd-5th grade students at one LiiNK intervention school (N= 117) and one control school (N= 290) for a total of 407 participants. Table 1 displays the participant breakdown by school, grade, and gender.

Table 1.
Participants by School, Grade, and Gender

School	Grade	Gender	N
Intervention			
	3rd	Male	23
	3rd	Female	18
	4th	Male	20
	4th	Female	21
	5th	Male	16
	5th	Female	19
	Total		117
Control			
	3rd	Male	44
	3rd	Female	47
	4th	Male	44
	4th	Female	47
	5th	Male	56
	5th	Female	52
	Total		290
Total			407

FitnessGram Results

Five testing measurements were used to assess students' fitness levels at both participating schools. These measurements included an aerobic capacity assessment (1 mile run or 20-meter PACER), muscular strength and endurance assessments (curl ups and pushups), a flexibility assessment (trunk lift), as well as a body composition measurement (BMI). Table 2 portrays the means and standard deviations for the raw scores of each assessment for both participating schools. A Multivariate Analysis of Variance (MANOVA) revealed significant main effects for school type (*Wilk's* $\lambda = .387$, $F(5, 391) = 124.06$, $p < .001$, $\eta_p^2 = .613$), gender (*Wilk's* $\lambda = .703$, $F(5,391) = 33.06$, $p < .001$, $\eta_p^2 = .297$), and grade (*Wilk's* $\lambda = .852$, $F(10,782) = 6.54$, $p < .001$, $\eta_p^2 = .077$) (Table 3). In addition, significant interaction effects were found between school type and gender (*Wilk's* $\lambda = .958$, $F(5,391) = 3.43$, $p < .005$, $\eta_p^2 = .042$) as well as school type and grade (*Wilk's* $\lambda = .952$, $F(10,782) = 1.95$, $p = .036$, $\eta_p^2 = .024$). Significant interaction effects were not found between grade and gender, or all three variables. The following section further breaks down results for each FitnessGram assessment.

Table 2.

Means and Standard Deviations of FitnessGram Assessments by School

	Intervention		Control			
	Mean	SD	Mean	SD	*F*	*p*
VO_2 max*	42.71	5.07	39.11	5.24	49.35	< 0.001
Curl Ups*	24.68	18.73	14.67	10.38	48.09	< 0.001
Pushups	11.03	5.69	11.31	7.87	.135	.714
Trunk Lift	9.15	1.71	9.19	3.18	.000	.998
BMI*	21.58	4.66	18.29	3.77	62.67	< 0.001

Note. *p<.0001

Table 3.
Main Effects for FitnessGram Results by School, Grade, and Gender

Source	*df*	*Wilk's λ*	*F*	*p*
School***	5, 391	.387	124.06	.0001
Grade***	10, 782	.852	6.54	.0001
Gender***	5, 391	.703	33.06	.0001
School by Grade*	10, 782	.952	1.95	.036
School by Gender**	5, 391	.958	3.44	.005
Gender by Grade	10, 782	.984	.650	.771
School by Grade by Gender	10, 782	.975	.987	.453

Note. *p<.05, **p≤.01, ***p<.0001

Aerobic Capacity. Aerobic Capacity was assessed by calculating students' VO_2 max from their respective assessments. Students' VO_2 max scores from the 20-meter PACER (control school) were calculated using the following Linear Model developed that was cross-validated by Mahar et al in 2011:

$$VO_2 \text{ Max} = 40.34533 + (0.21426 \text{ x PACER laps}) – (0.79472 \text{ x BMI}) + (4.27293 \text{ x gender}) + (0.79444 \text{ x age})$$

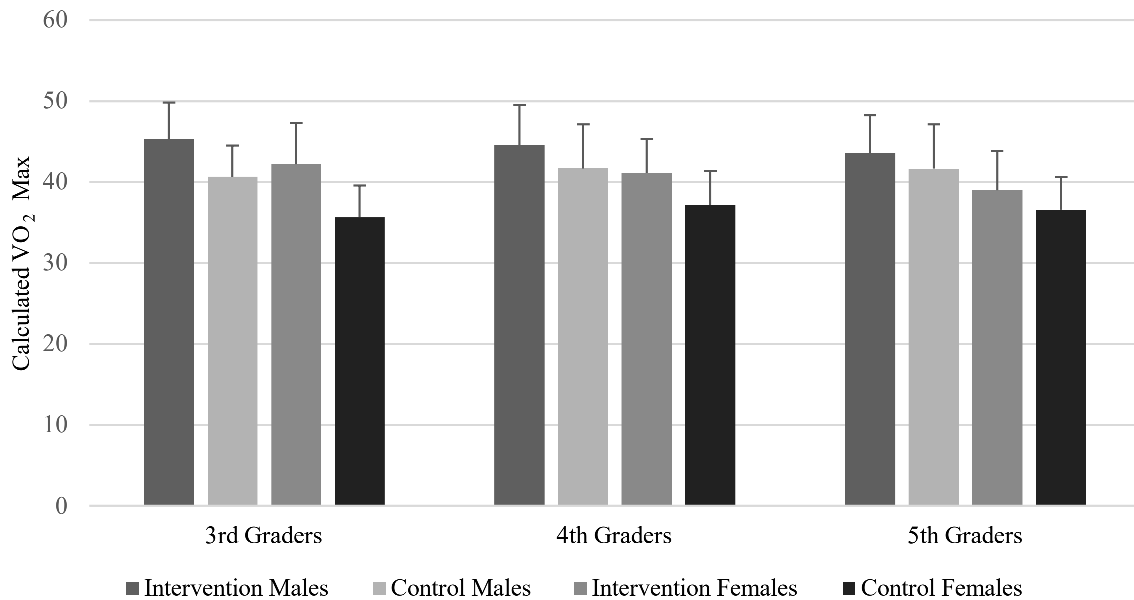
To calculate students VO_2 max from the one-mile run (intervention school), the following formula was used following the regulations enforced by the California Department of Education for fitness testing using the FitnessGram (2015):

$$VO_2 \text{ Max} = (.21 \text{ x age x gender}) – (.84 \text{ x BMI}) – (8.41 \text{ x time}) + (.34 \text{ x time x time}) + 108.94$$

It was hypothesized that intervention students would perform better in aerobic capacity assessments than control school students. Follow up univariate Analyses of Variance (ANOVAs) revealed significant differences for aerobic capacity by school ($F(1,395) = 49.35$, $p < .0001$, $\eta_p^2 = .111$) and gender ($F(1,395) = 73.70$, $p < .0001$, $\eta_p^2 = .157$), but not by grade ($F(2,395) = .632$, $p = .532$, $\eta_p^2 = .003$). A significant interaction effect was found between school type and grade ($F(2.395) = 5.10$, $p =.007$ $\eta_p^2 = .025$), but not between school type by gender, gender by grade, or all three variables. Mean score comparisons indicated that 3rd-5th grade intervention school students consistently portrayed higher VO_2 max scores when compared to 3rd-5th grade students at a control school (see Figure 1). Thus, we accept our hypothesis that intervention school students would perform better in aerobic capacity assessments than control school students.

Figure 1.

Aerobic capacity comparison by school, grade & gender



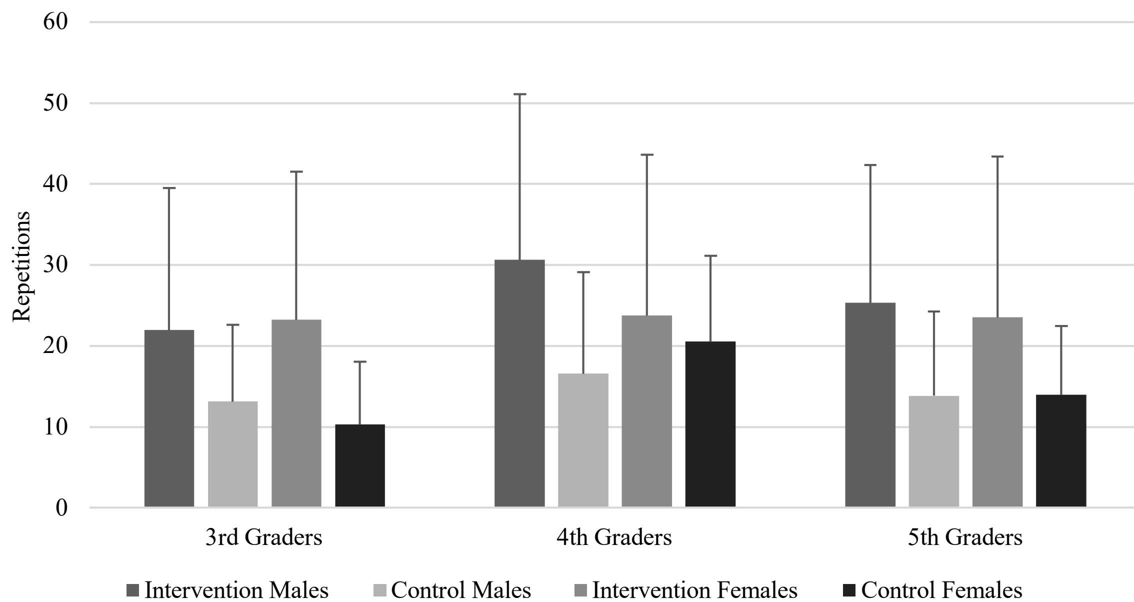
Curl Ups. Abdominal strength and endurance were assessed by having students complete curl ups to exhaustion. It was hypothesized that the intervention school students would perform more repetitions than control school students.

Follow up ANOVAs were calculated examining curl up assessments by school, grade and gender. Significant differences were found among school type (F(1,395) = 48.09, p < 0001, η_p^2 = .109) and grade (F(2,395) = 5.53, p= .004, η_p^2 = .027), but not gender (F(1, 395) = .504, p = .48 η_p^2 = .001). Post hoc results for grade revealed significant differences between 3rd and 4th graders (p < .0001) as well as 4th and 5th graders (p = .007). Significant interaction effects were not found between any variables.

Mean score comparisons by grade portrayed that 3rd-5th grade intervention school students consistently performed more curl ups when compared to 3rd-5th grade students at a control school (Figure 2). Specifically, the largest difference between schools was in third grade. Thus, the hypothesis was accepted that intervention school students would portray better abdominal strength and endurance than control school students.

Figure 2.

Curl up comparison by school, grade & gender

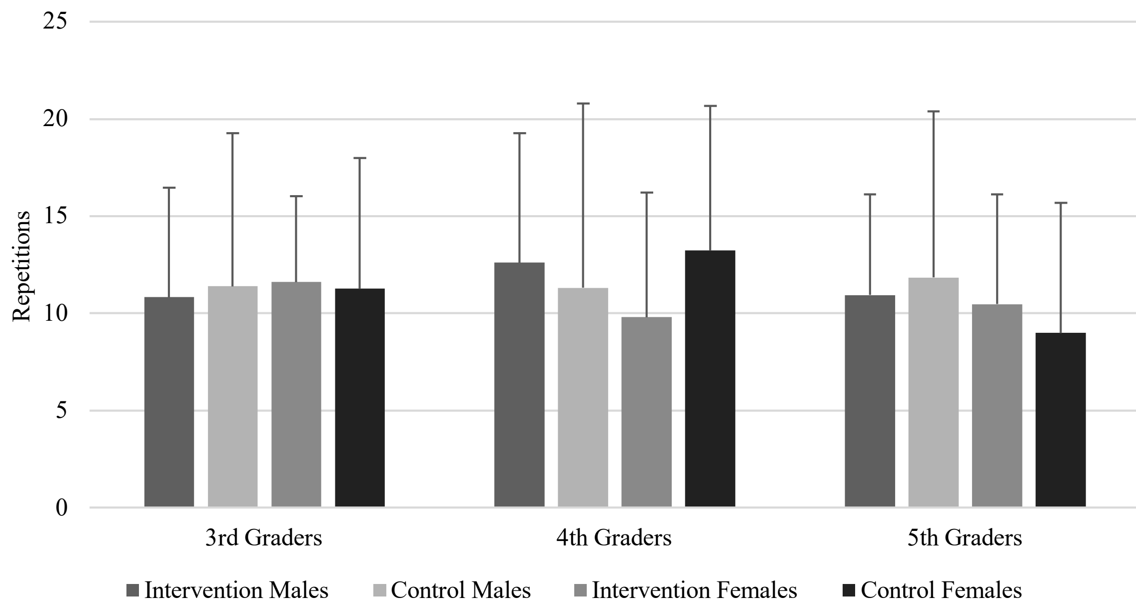


Pushups. Upper body strength and endurance was assessed by having students' complete pushups to exhaustion. It was hypothesized that the intervention school students would perform more repetitions than control school students.

Follow up ANOVAs were calculated examining pushup assessments by school, gender and grade. Non-significant differences were found among school type (F(1,395)=.135, p=.714, η_p^2=.000), gender (F(1, 395) = .532, p = .466, η_p^2 = .001), and grade ($F(2, 395) = .713$, $p = .491$, $\eta_p^2 = .004$) (Figure 3). No significant interaction effects were found among any of the variables. Thus, we reject our hypothesis that intervention school students would portray better upper body strength and endurance than control school students.

Figure 3.

Pushup comparison by school, grade & gender

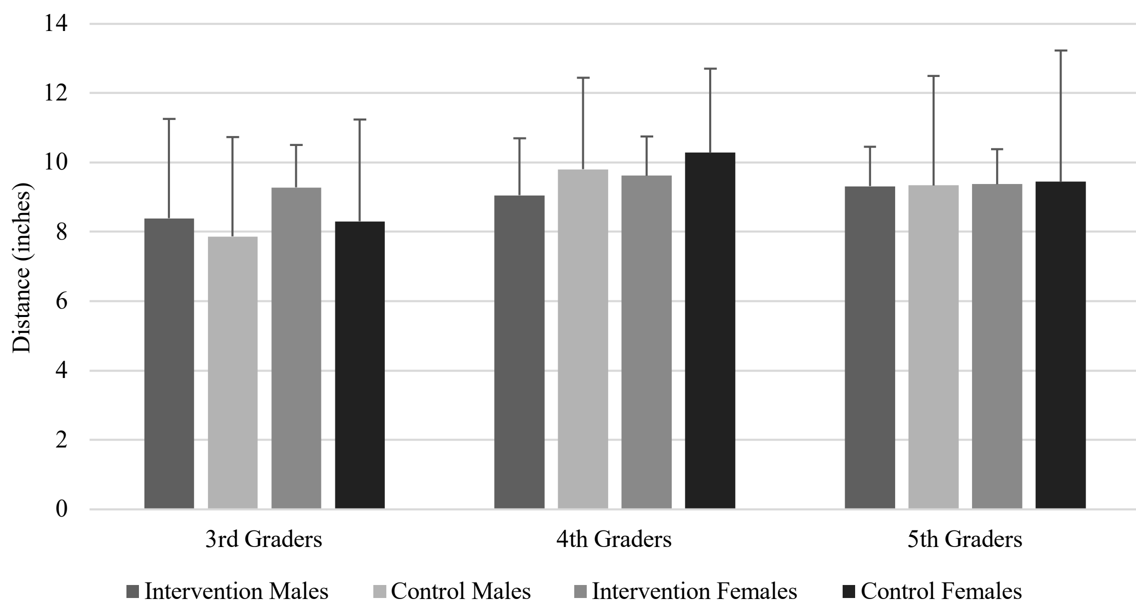


Trunk Lift. Flexibility was assessed by calculating students' trunk lift assessment. Trunk lift scores examined the differences in trunk flexibility between the two schools. It was hypothesized that the intervention school students would portray better flexibility than control school students.

Follow up ANOVAs were calculated examining trunk flexibility differences by school, grade and gender. A significant difference was found by grade ($F(2,395) = 5.88$, $p = .003$, $\eta_p^2 = .029$), but not by gender ($F(1, 395) = 1.90$, $p = .169$, $\eta_p^2 = .005$) or school type ($F(1, 395) = .000$, $p = .998$, $\eta_p^2 = .000$) (Figure 4). No significant interaction effects were found among any of the variables. Post hoc results for grade revealed that 3rd graders performed significantly worse than 4th (*p* < .0001) and 5th graders (*p* = .004). Interestingly, while 3rd graders performed significantly worse than older students, LiiNK 3rd graders performed superior than their control school counterparts. Mean score comparisons for 3rd grade males and females across schools showed that LiiNK 3rd grade males (8.39 ± 2.86 inches) and females (9.28 ± 1.23 inches) performed better than respective 3rd grade males (7.86 ± 2.87 inches) and females (8.3 ± 2.94 inches) at the control school. The hypothesis was rejected that intervention school students of all grades would portray better trunk flexibility than control school students.

Figure 4.

Trunk lift comparison by school, grade & gender

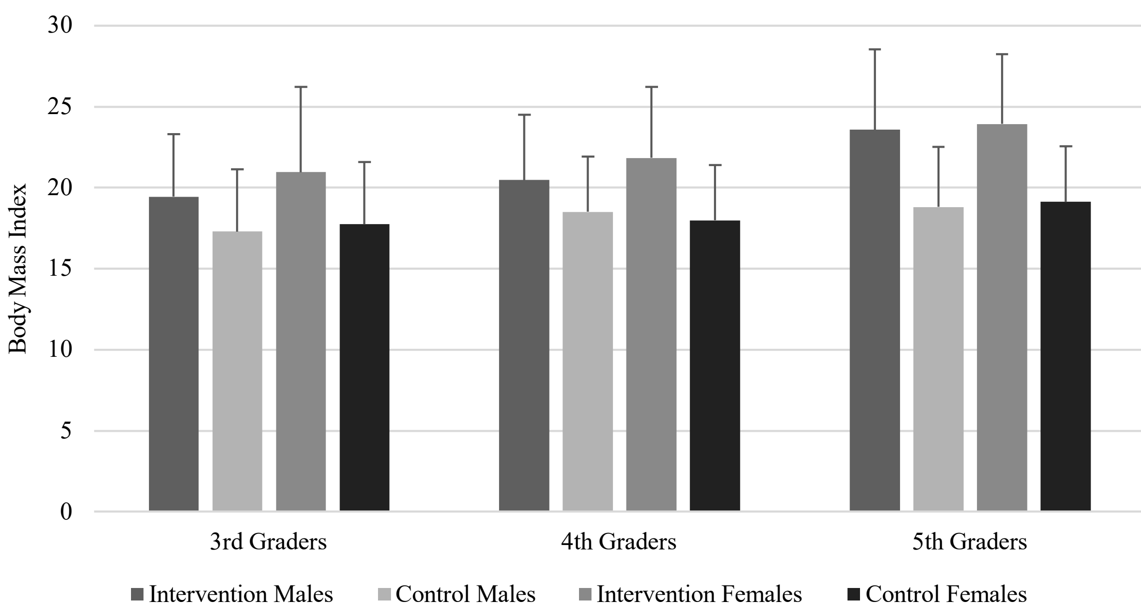


Body Composition. Body composition was assessed by calculating students' BMI using their height, weight, and age. BMI scores examined the differences in body composition between the two schools. It was hypothesized that the intervention school students would portray healthier BMI scores than control school students.

Follow up ANOVAs were calculated examining BMI differences by school, grade and gender. A significant difference was found among school type ($F(1,395) = 62.67$, $p <. 0001$, $\eta_p^2 = .137$), yet in the opposite direction as hypothesized. In this study, control school students had significantly lower BMI scores than students of the intervention score (Figure 2). A significant difference was also found by grade ($F(2,395) = 11.15$, $p <.0001$, $\eta_p^2 = .053$), but not by gender ($F(1,395) = 1.78$, $p = .183$, $\eta_p^2 = .004$). Post hoc results for grade revealed significant increase in BMI ratings between 3rd and 5th graders ($p < .0001$). No significant interaction effects were found among any of the variables. On these terms, we reject our hypothesis that intervention school students would portray healthier (i.e. lower) body composition than control school students.

Figure 5.

Body composition comparison by school, grade & gender



Chapter V: Discussion

The purpose of the current study was to investigate the effectiveness of a multiple recess school intervention on fitness in school-aged children. This research project built on previous LiiNK intervention research which indicated that 1st and 2nd grade intervention school students are significantly more physically active and experience less negative mood states than 1st and 2nd grade students at a traditional school (Farbo, 2018; Farbo et al., 2020). The results from this study indicated that intervention school students performed significantly better in aerobic capacity and abdominal strength and endurance assessments, but not in upper body strength and endurance or trunk flexibility assessments. Additionally, a significant difference was found in BMI between schools in the opposite direction than hypothesized, as control school students portrayed lower BMI scores than intervention school students.

In this study, intervention school students performed significantly better in the aerobic capacity assessment (i.e. VO_2 max) than the control school. Both male and female intervention students of each grade (3rd-5th) averaged better scores than students at the respective control school. This could be an indicator that students at the intervention school are experiencing cardiovascular benefits from the additional time in unstructured play. The CDC recommends that children achieve at least 60 minutes of moderate to vigorous physical activity daily to maintain a healthy lifestyle (CDC, 2019). Research suggests that increased time for physical activity in school can offer students many cardiovascular health benefits, such as reduced risk for metabolic syndrome, decreased incidences of asthma, and an increase in cardiovascular fitness levels (Erwin et al., 2014). Students at the intervention school are offered the opportunity to obtain this goal at school through their unstructured play breaks, while students at the control school are only offered 20 minutes of school time for unstructured physical activity. While these results are promising, they must be interpreted with caution due to the difference in testing measurements between conditions (PACER and one mile run).

Results of this study also showed that intervention students performed significantly better in abdominal strength and endurance testing than students matched by grade and gender at the control school. This could be an indicator that intervention students are experiencing abdominal health, strength and endurance benefits from the decrease in sedentary time and increase time for physical activity in school. Improving abdominal health, strength and endurance in childhood is a growing concern due to the rise in childhood obesity. Research suggests that decreasing sedentary activity levels or engaging in higher-intensity physical activity to be associated with decrease in waist circumference, less visceral fat, and overall improvements in health and fitness (Kim & Lee, 2009). The largest difference between conditions was found in 3rd grade. This could be an indicator of early development of abdominal strength and endurance at intervention schools through increased time for physical activity and frequent breaks from sedentary behavior.

A significant difference was not found between conditions for upper body strength and endurance testing. This may be in result of the lack of upper body involvement in intervention student’s unstructured play breaks. Common activities reported during LiiNK play breaks include running in fields, digging in the dirt, and dancing. Increasing opportunity for unstructured upper body strength and endurance activities, such as monkey bars, rock climbing, or rope climbing, might create the changes we expected to see in the category.

A significant difference was not found between conditions for trunk flexibility except for third grade males and females. The difference found in this population could be an indicator of early development of trunk strength and flexibility in comparison to control school. While researchers were expecting to see a significant difference in flexibility between conditions for all grades, the trunk flexibility is known for its low reliability and high passing rates. Instead, the FitnessGram suggests the use of the back saver sit and reach to assess flexibility due to high reliability and validity. The trunk lift is often used due to its ease and lack of equipment, whereas the back saver and sit and reach requires more time and equipment. Due to the nature of the testing measurement used, these results should be interpreted with caution.

Results of this study indicated that control school students had significantly lower BMIs than intervention school students. While researchers expected to see lower body compositions measurements (i.e. less prevalence of obesity) at intervention schools than control school, this could be explained by the additional muscle mass we expect intervention school students to have due to increased daily physical activity. BMI scoring does not consider fat and muscle mass when assessing an individual’s body composition. A muscular individual might report a high BMI because of extra muscle mass and be miscategorized as obese (Buss, 2014). Thus, the use of a BMI is a limitation in this study, as it does not tell us where the differences lie (muscle mass vs. fat mass) between these populations.

Despite intervention school students having higher BMI scores, they still performed significantly better in aerobic capacity and abdominal strength and endurance assessments. This finding might be explained by the poor reliability of BMI to assess body composition between fit and unfit populations, as BMI cannot differentiate between fat and muscle mass.

Cardiovascular and abdominal health and wellness are negatively associated with obesity, metabolic syndrome, and fitness (Erwin, 2014; Kim & Lee, 2009). Healthier aerobic capacity and abdominal strength and endurance could be indicators that the intervention is indeed succeeding in improving fitness levels and helping combat health risks such as obesity, metabolic syndrome, and poor cardiovascular health.

Limitations

This study did not come without limitations that should be addressed. First and foremost, the COVID-19 pandemic created many barriers. Initially, researchers planned on offering training to data collectors from both schools prior to data collection, as well as having expert data collectors oversee data collection to ensure all data collectors followed the same testing protocol. Due to limited school access and decreased time spent in school by students, researchers chose to reflect upon data from the previous school year (2019-2020). This was a major limitation of the study, as researchers were unable to standardize or offer training prior to data collection, oversee data collection to ensure proper testing protocols, ensure students were allowed adequate practice attempts, or standardize which assessments were utilized to measure aerobic capacity.

Additionally, the difference in sample sizes between the control school and intervention school was a limitation of this study, as the control school had nearly a 2.5 times larger sample size. The difference in sample sizes could skew results, as minor changes in intervention school data could create major change in outcomes. In addition, the sample size for 5th grade was significantly smaller than 3rd or 4th grade populations, increasing difficulty to track developmental changes between grade levels.

As briefly mentioned above, another limitation of this study is that the control school and intervention school used different measures to assess aerobic capacity. Researchers have created and cross-validated formulas that calculate a student's VO_2 max based off their gender, age, BMI, and their respective 20-meter PACER or one-mile walk or run results, allowing researchers to compare VO_2 max scores as well as HFZ placements despite the difference in testing tools. The recent change in FitnessGram standards were created to combat the excessively high passing rates for young girls and resolve the classification disagreement between PACER and one mile run (The Cooper Institute; *New FitnessGram® Healthy Fitness Zone® Standards*). While we were able to compare results of students calculated VO_2 max scores using the new FitnessGram standards, the difference in assessments is a limitation in the study, as the PACER and one mile run present different challenges, motivation levels, and environmental conditions (Plowman & Meredith, 2013). Thus, great caution must be used when analyzing aerobic capacity results across different assessments.

Another limitation worth noting is that the formula used by the FitnessGram for calculating students' VO_2 max from their PACER performance using laps, age, and gender is proprietary to Human Kinetics and The Cooper Institute and therefore was not assessable for research purposes (California Department of Education, 2015). Instead, this study used a formula that was created and cross-validated by Mahar and colleagues (2011) to assess control school students' VO_2 max from their PACER performance. Although Mahar and colleagues found that their linear model had better construct reliability than previous models used to calculate VO_2 max, it is still not the formula that FitnessGram software uses to assess aerobic capacity and therefore must be acknowledged as a limitation.

The use of the trunk lift to assess flexibility is also limitation of this study. This assessment is known for its high passing rates, which can explain the lack of difference in flexibility scores between schools. This assessment is often used for its ease and lack of equipment necessary. Future research should choose a stronger assessment to assess flexibility.

Future Directions

Future research should explore fitness differences at other grade levels and across time to see if any longitudinal effects exist over time in students' fitness levels. Future research should consider students' motivation and efficacy towards physical activity at traditional schools and intervention schools across time. Also, future research should assess students task efficacy and motivation, which are important factors to consider when analyzing student's testing performance. Moving forward, future researchers should provide and standardize practice assessments throughout the school year prior to testing day by. Providing training for all testing administrators to standardize protocol, procedures, and assessments between schools. In addition, studies could ensure the researchers are present during data collection at both schools to further increase interrater reliability. Lastly, future research should include a more valid and reliable body composition and flexibility assessment, as BMI does not account for muscle mass and trunks lifts are known to be unreliable due to its high passing rate. Due to BMI's high unreliability, the FitnessGram recommends the use of Bioelectrical Impedance Analysis (BIA) to assess body composition. Currently in body composition research, BIA is on the horizon as a more reliable tool to assess body composition (Plowman & Meredith, 2013).

Conclusions

This exploratory study investigated the effectiveness of a multiple recess school intervention on fitness in grades 3-5 children using components of the FitnessGram. Participants included grades 3-5 children participating in the LiiNK Project and receiving multiple recesses per day for a total of 60 minutes of recess per school day (N= 117) and grades 3-5 children at a control school (N= 290), receiving one 20 minute recess break per day. Results indicated that the intervention school students performed significantly better than control school students in aerobic capacity and abdominal strength and endurance assessments, but not in upper body strength and endurance or flexibility assessments. Results also did not support the hypothesis that intervention students would have lower BMI scores than traditional school students, as a significant difference was found in the opposite direction.

These results are promising for interventions such as the LiiNK Project. LiiNK researchers have found academic, emotional and health and fitness improvements in result of increased unstructured play which increases appeal for educator leaders to create change in the American school system (Farbo, 2018; Farbo et al., 2020; Rhea & Rivchun, 2018). Interventions such as the LiiNK Project can be used to reverse current trends of obesity and burnout in children by creating a healthier, holistic learning environment that promotes whole-child development and wellness. While results are encouraging, this data should be interpreted with caution, due to the exploratory nature of this study.

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ABSTRACT

THE IMPACT OF INCREASED UNSTRUCTURED PLAY ON FITNESS LEVELS IN SCHOOL-AGED CHILDREN

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The purpose of this exploratory study was to investigate the effectiveness of a multiple recess school intervention on fitness in school-aged children. Students grades 3-5 participating in the LiiNK Project and receiving multiple recesses per day for a total of 60 minutes of recess per school day (N= 117) were compared to students grades 3-5 at a control school (N= 290), who received one 20 minute recess break per day. Students' fitness levels were assessed using the FitnessGram, a reliable and validated fitness testing battery for school aged children, including aerobic capacity, curl ups, pushups, trunk flexibility, and BMI assessments. Results indicated that intervention school students performed significantly better than control school students in aerobic capacity and abdominal strength and endurance assessments, but not in upper body strength and endurance or flexibility assessments. Results did not support the hypothesis that intervention students would have lower BMI scores than control school students, as a significant difference was found in the opposite direction. Researchers recommend future research to use students' body fat percentage and muscle mass to analyze body composition, as BMI does not decipher between muscle and fat mass. Future research should also standardize testing measurements and protocols between schools, use a more reliable flexibility assessment, and increase sample size. Results from this study

are promising for promoting similar interventions to help reverse current trends of obesity by combatting excessive sedentary time and physical inactivity in school.