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The Impact of Socioeconomic Status on Physical Literacy in Children

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Landing Strategies and Physical Ability between High-Resourced and Low-Resourced Children

Context: Physical literacy is a growing concept throughout the United States. In order to be physically active, children must develop physical literacy, which is the competency to control their body, and the confidence and motivation to be active. There is a critical need to identify children with low physical literacy and/or at risk for sustaining musculoskeletal injuries and factors associated with proper development. Socioeconomic status of children's living communities may influence opportunities for physical activity and motor development, but this has not been examined in relation to physical literacy in the United States. The purpose of this study was to evaluate physical literacy competency and landing strategies in youth between a low-resourced community and a high-resourced community. **Methods**: A cross-sectional study design was used to compare children between high-resourced (HIGH) and low-resourced (LOW) categories (LOW: >50% free/reduced lunch; HIGH: <49% free/reduced lunch) on standing strategies and fundamental movement skills. Physical competency during tasks related to fundamental movement skills were assessed using the validated *PLAYfun* assessment tool and divided into five domains: locomotor, balance, upper extremity object control, lower extremity object control and running. Tasks within each domain were evaluated using a 100-point visual analog scale (100= proficient, 0= not competent). The average total score across all tasks within each domain was calculated for 5 separate composite competency scores. Landing technique was assessed using the Landing Error Scoring System (LESS). The average total LESS score across 3 trials

were calculated for a single LESS score per participant. Two-way analyses of variance were used to compare physical literacy competency in each domain (locomotor, balance, upper extremity object control, lower extremity object control and running) and LESS scores between high and low-resourced communities and schooling level. An alpha level was set at 0.05. **Results:** There was a statistically significant interaction between environment and school level for LESS scores ($p=0.02$), Balance ($p=0.02$) and Running ($p<0.001$) with children in low-resourced environments and elementary school children being at a higher risk for poor motor development. **Conclusion:** Findings from this study reinforce the concern that children in low-resourced environments, specifically those in elementary school, may not have the neuromuscular control or fundamental movement skill competency needed to be active for life, which places them at risk of comorbidities associated with a sedentary lifestyle. Children in schools with a low SES need to be aware of the risk of developing poor fundamental movement skills and increasing their risk of injury.

Motivation and Confidence of Physical Literacy in High-Resourced and Low-Resourced Environments

Context: Physical literacy is a growing concept throughout the United States. In order to be physically active, children must develop physical literacy, which is the competency to control their body, and the confidence and motivation to be active. Socioeconomic status (SES) may influence activity levels with children in higher SES being more active than children in low SES. Therefore, the purpose of our study was to evaluate confidence and motivation between high-resourced and low-resourced environments in both elementary and middle school children **Methods**: A cross-sectional study design was used to compare children between high-resourced (HIGH) and low-resourced (LOW) categories (LOW: >50% free/reduced lunch; HIGH: <49% free/reduced lunch) on motivation and confidence metrics related to physical activity participation. Confidence and motivation were determined by the validated PLAY-Self questionnaire. Chi-squared tests of association were performed on each individual question to determine if any significant associations existed in motivation and confidence between high-resourced and low-resourced groups by schooling level. **Results:** For elementary school children (n=216), there was a statistically significant association between environment (HIGH, LOW) and perception of skill (question 8) ($p=0.004$), importance of activity (question 9) ($p<0.001$), happiness with being active (question 10) ($p=0.001$), perception of their body allowing activity (question 12) ($p=0.01$), and understanding of directions (question 14) ($p=0.014$) with participants in HIGH environments reporting great confidence and motivation than children in LOW environments. For middle school children (n=202), there was a statistically significant difference between environment (HIGH, LOW) in eagerness to try new activities (question 16) ($p<0.001$), and the need to not practice

skills (question 18) (p=0.003) with children in LOW environments reporting great confidence and motivation than children in HIGH environments. **Conclusion:** Findings from this study reinforce the variability between confidence and motivation in sport between high and low-resourced environments. There is discrepancy that elementary school children are less confident and motivated than middle school children. Future studies should look to see if addressing the psychological components of physical literacy improves physical activity participation in youth.

I. REVIEW OF THE LITERATURE

1.1 Public Health Perspective

1.11 Obesity Epidemic

The obesity epidemic is a serious public health concern. Rates of obesity have continued to rise throughout the United States over past decades. For adults over 20 years old, weight status is frequently defined by body mass index (BMI), which is expressed as weight (kg) divided by height (m) squared.[1] Weight status is commonly broken into four groups: underweight, healthy, overweight and obese (Table 1). Obesity is further broken down into three classes. Childhood weight status is not only calculated by weight and height, but also by age. Most recently, in 2001, the National Center for Health Statistics and the National center for Chronic Disease Prevention and Health Promotion collaborated on a graph that displays the normative values in the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles for BMI-for-age and weight-for-stature for both males and females (Appendix A, Appendix B). Approximately 68% of adults were classified as overweight and obese and 34% are obese according to the latest statistic from the National Health and Nutrition Examination Surveys (NHANES).[2] Some sources report that 15-20% of children and adolescents in the U.S are considered obese, while others report a greater prevalence of one-third of American children as being overweight or obese.[3] Obesity is linked to many health concerns and comorbidities in adults including type 2 diabetes, hypertension, cancer and other costly

Obesity Chart		
	BMI kg/m^2	Obesity Class
Underweight	<18.5	
Normal	18.5-24.9	
Overweight	25.0-29.9	
Obesity	30.0-34.9	I
	35.0-39.9	II
Extreme Obesity	40.0	III

Table 1: Range of BMI to weight status
Modified from Mitchel et al 2011

diseases.[1] It is estimated that 90% of individuals with type 2 diabetes are obese.[4] Further, there is a positive correlation demonstrating when BMI increases, healthcare costs also increase.[5] While many of these comorbidities are usually only seen in adults, more and more children are developing risk factors for chronic diseases, such as hypertension and type 2 diabetes, at a younger age.[6, 7] Children who are obese are likely to stay obese throughout adolescence and adulthood. The early arrival of these ailments will continue to increase the rise of healthcare costs, which are already estimated to exceed $14 billion annually.[8, 9] Thus it is important to consider feasible, cost effective solutions to help mitigate the burdens of childhood obesity.

1.12 Physical Inactivity

Physical activity is an important factor in preventing obesity. The Centers for Disease Control and Prevention (CDC) recommends that adolescents ages 6-17 years old complete 60 minutes of moderate to vigorous physical activity daily.[2] Much of the population is not achieving these levels of physical activity throughout the day with the World Health Organization (WHO)[10], National Strength and Conditioning Association (NSCA)[11] and the International Olympic Committee (IOC)[12] all highlighting that today's youth population is alarmingly less physically active when compared to previous generations. Students, on average, spend 8 hours or more in school during a typical weekday, making the school setting key for providing opportunities for physical activity. There have been multiple efforts to increase physical activity-related benefits in youth with hopes of not only improving activity in children, but also improving and optimizing academic performance.[13, 14]

Physical activity's positive effects on academic performances are widely accepted in published literature.[15, 16] Much of the literature shows that research-led interventions during school hours have a strong buy-in during the intervention period but have poor retention after the organized program ends.[13, 14] There also is conflicting evidence, from a meta-analysis, regarding classroom-based physical activity on children's physical activity levels and their impact on physical activity outside of the classroom.[13] For example, a study done in Australia looking at 3rd and 4th graders demonstrated that physical activity in school does not link to physical activity levels outside school. With this conflicting data, more research is needed to investigate the efficacy of a classroom-based intervention and assessments on physical activity levels in children.

As current intervention strategies are not creating permanent changes in physical activity levels, alternative intervention initiatives need to be taken into consideration to assist with the public health crisis of childhood physical inactivity. Some literature suggests a multi-level approach of appealing to multiple stakeholders, such as parents, coaches and educators, to improve activity in youth.[17] Involvement of different stakeholders for the youth population can assist with understanding the importance of activity and provide support for continued activity.

1.2 Barriers for Physical Activity

1.21 Socioeconomic Status

There are many different factors that influence childhood obesity. While obesity is largely influenced by diet and activity level, obesity is also indirectly affected by environmental factors.[3] Davidson and Birch characterized childhood obesity into 3

main influences: (a) child characteristics, (b) parenting styles and family characteristics, including peers, and (c) community and demographic characteristics, including the schooling system. Further these potentially non-modifiable environmental factors should be considered when evaluating risk factors for childhood obesity.[18] Although socioeconomic status (SES) was not independently mentioned, SES has been shown to influence the likelihood of activity among children, where higher levels of activity have consistently been noted among high SES groups relative to lower SES groups.[19-22] Physical activity may be lower among children from low SES families due to parental choices and lifestyles, such as less leisure time, less knowledge of the benefits of exercise as a result of lower levels of education[22], and fewer financial resources to support children's activities. Differences in neighborhood safety, including fewer safe recreation areas being available in neighborhoods with a large proportion of low SES minority families may also influence activity levels.[18] Higher levels of activity have been observed among non-Hispanic white children in comparison to Asian, Hispanic, and African-American children.

In a qualitative study, low-income youth living in a predominantly high-income area were interviewed with the purpose of understanding sport involvement. After being coded for themes, the authors found that cost was not the only factor influencing sport participation. Self-reported knowledge and confidence of the youth being able to complete sport related activities had a large sway on competing in sport. [21, 23-26]

1.22 Defining Socioeconomic Status

Socioeconomic status is a challenging construct to define. In literature, socioeconomic status (SES) is often defined as a measure of one's combined economic

and social status and tends to be positively associated with better health.[27] Past literature has been broken down into urban, suburban and rural settings[28], as well as adult income status.[29] Another way to dichotomize students is by free or reduced lunch eligibility against those that do not qualify for lunch assistance. Lunch assistance is calculated using the national poverty level. To qualify for free lunch, you must fall below the poverty level multiplied by 1.30 and for reduced lunch, the poverty level multiplied by 1.85.[30] The national poverty level varies for Alaska and Hawaii but are the same across the other 48 states, District of Columbia and all other territories. These numbers are updated each year and apply for the entirety of the following academic year. Currently, the rates for the 2018-2019 school year are displayed in Table 2.

Income Guidelines for the Child Nutrition Programs[14] Effective July 1, 2018–June 30, 2019

Household Size	Federal Poverty Guidelines	Free Meals Maximum Household Income (130% of Poverty)			Reduced-Price Meals Maximum Household Income (185% of Poverty)		
	Annual	Annual	Monthly	Weekly	Annual	Monthly	Weekly
1	$12,140	$15,782	$1,316	$304	$22,459	$1,872	$432
2	$16,460	$21,398	$1,784	$412	$30,451	$2,538	$586
3	$20,780	$27,014	$2,252	$520	$38,443	$3,204	$740
4	$25,100	$32,630	$2,720	$628	$46,435	$3,870	$893
5	$29,420	$38,246	$3,188	$736	$54,427	$4,536	$1,047
6	$33,740	$43,862	$3,656	$844	$62,419	$5,202	$1,201
7	$38,060	$49,478	$4,124	$952	$70,411	$5,868	$1,355
8	$42,380	$55,094	$4,592	$1,060	$78,403	$6,534	$1,508
Add for each additional	+ $4,320	+ $5,616	+ $468	+ $108	+ $7,992	+ $666	+ $154

Table 2: Guidelines taken directly from the Food Research and Action Center (FRAC)

The utilization of free or reduced lunch to calculate a high or low resourced area is opportune due to the ease of collection. Asking about lunch status appears to be less embarrassing or invasive than asking about poverty level or household income. In the state of Connecticut, each school posts the percentage of students that qualify for reduced or free lunch, which is both easily assessable and public record.[30] Those

reports that showed greater than 50% of the school falling into the lunch assistance programs were considered low-resourced environments. Those reports that shower fewer than 49% of the school falling into the lunch assistance programs were considered high-resourced environments.

1.3 Physical Literacy

1.31 History of Physical Literacy

In order for physical activity to be an important part in a child's life, they must be physically literate. Physical literacy is a popular construct around the world but is a relatively new and growing concept throughout the United States. The term "physical literacy" has been dated back as far as the 1800's from the United States Army Corps of Engineers in 1884. There were scattered uses throughout the 1900's with a new emergence in the early 1990's. Dr. Margaret Whitehead, the primary host of a Physical Literacy Conference in 2010 and co-founder of the International Physical Literacy Association in 2015, proposed that physical literacy supports the life-long pursuit of physical activity. Physical literacy is often confused with "physical activity", "fundamental movement skills" or "physical education". While there are components of these that add to physical literacy, they miss the cognitive and behavioral component of physical literacy.

Due to physical literacy being a relatively new concept, there are various definitions in the literature. The International Physical Literacy Association (IPLA) defines physical literacy as "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life".[31] Canadian Sport for Life (CS4L) defined physical literacy

as “the mastering of fundamental movement skills and fundamental sport skills that permit a child to read their environment and make appropriate decisions, allowing them to move confidently and with control in a wide range of physical activity situations”.[32] The Aspen Institute defined physical literacy as “the ability, confidence and desire to be active for life”.[33] These are the most popular definitions, all coming from Canadian literature. Although both are often cited, the IPLA definition seems to have a clearer expectation that physical literacy is much more than simply movement skills. There are multiple pillars that are used within the assessment of physical literacy with the majority falling under three: Physical Ability, Motivation, and Confidence. CS4L does not appear to capture the influence that motivation has on physical literacy. Each of these constructs likely influence each other and together control overall physical literacy.

1.32 Physical Ability

As the previous definitions mention, physical ability is an important part in being physically literate. A person must have the cooperation between muscles or muscle groups to produce a purposeful action or movement, or motor coordination. Early childhood and adolescence are the key time to develop these skills to be physically literate throughout life. The fundamental movement skills include the various gross motor skills, such as running, balancing, kicking, etc. Many researchers agree that fundamental movement skills reach their peak development between 10-12 years old or through puberty, however, there is limited to no evidence supporting this theory. Fundamental movement skills are the basic movement foundations that can be built upon and refined with age.

Fundamental movement skills are often categorized into 12 specific motor tasks: balancing, running, jumping, catching, hopping, throwing, galloping, skipping, leaping and kicking. Many investigators further categorize these tasks down into locomotor (e.g. running, hopping, skipping), balance, and manipulative skills (e.g. throwing, catching). There is literature to support that greater physical activity is positively associated with throwing-catching and leaping skills.[34] Increasing fundamental movement skills improves physical competence or capability which is associated with higher physical activity.[35] Children who are physically active have a greater chance of improving fundamental movement skills.

1.33 Motivation

When discussing physical literacy, the first thought is often the motor competence component, however, physical literacy also includes psychological domains. In order to be physically active, a child must *want* to be physically active. Much of the literature uses social pressure as the main motivator for sport participation or lack of participation.[36] If the peers of a child are participating in sports, a child is more likely to participate themselves, however, this reverses as the child matures. In a qualitative study, children reported that social exclusion could be attributed to many factors, including, early participation, particular abilities and lack of understanding rules.[37] Motivation is a cognitive element and requires the understanding of health benefits. If a child does not have the motivation to participate in physical activity or if they were not afforded the exposure to such activities as a young child, they may feel they are unable to perform certain skills necessary to keep up with their peers and therefore will not want to participate.

1.34 Confidence

Confidence is a behavioral element of physical literacy, in which a person must be engaged and participatory in physical activities. The goal is also that physical activity fosters enjoyment. Motor competence and psychological elements have a strong link that is important to note during physical activity. In preliminary (unpublished, DiStefano et al) data, children were able to predict their motor competence in a set of tasks, proving that confidence is an important variable to consider when evaluating for physical literacy. In a study by Washburn et al. younger children overestimated their physical ability while older children were able to accurately predict their physical ability.[38]

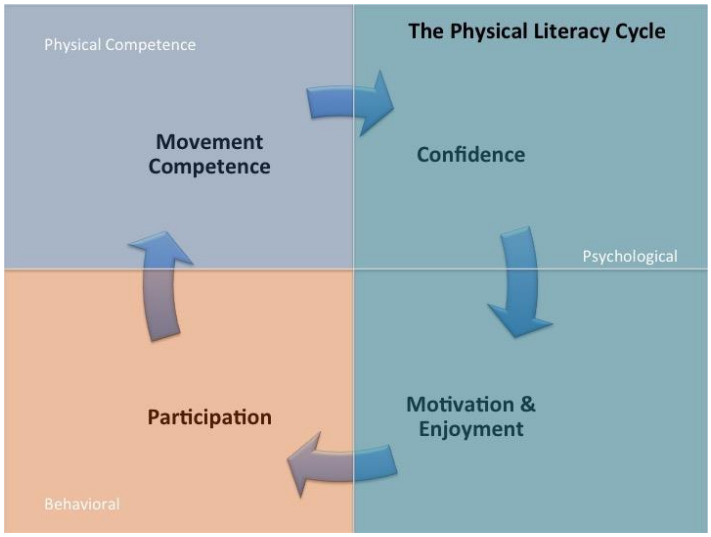

Figure 1: Physical Literacy Cycle. Modified from Taplin 2013. The physical literacy cycle highlights the connection between physical competence and the affective domain (confidence/motivation/enjoyment) leading to participation.

Although the components are independent, there is a positive feedback loop associated with each of these constructs. Figure 1, first proposed by Liz Taplin at the International Physical Literacy Conference in 2013 highlights that in order to foster physical activity participation, individuals must demonstrate movement competence, confidence and motivation. Together this feedback loops highlights that all three elements need to be addressed in order to improve overall physical activity participation.

1.35 Assessments

While the United States is taking more of a role in acknowledging physical literacy as an important factor in childhood development and long-term health, many of the physical literacy assessments were developed in other countries, including several in Canada. The Physical Literacy Assessments of Youth (PLAY) tools are common and capture all the domains of physical literacy. PLAY Fun assesses movement-based competence in 18 land-based tasks. Each task is scored on a 100mm visual analog scale. The PLAY Fun tool has undergone reliability and validity evaluation in the laboratory (unpublished) for the motor competence component with very good to excellent test-retest reliability (r=0.92), and very good inter-rater reliability using two-way mixed, consistency, average-measures ICC (ICC=0.89).[31] Further, the PLAY Self tool is used to capture the psychological aspects related to physical literacy. The PLAY Self tool consists of 13-items that assesses confidence in participation, confidence in the performance of activities and perceived movement competence, confidence and enjoyment. The PLAY Self test-retest reliability is very high (r=0.94) in grades 4 to 6, and in youth (grade 8, 10 and 12) (unpublished).[31] PLAY Inventory assesses the behavioral component by looking at participation in society by checking off each activity they partake in with the total number tallied.

The Canadian Assessment of Physical Literacy (CAPL) [39] is an additional physical literacy outcome tool which potentially expands past the domains of physical literacy included in other physical literacy outcome measures. Specifically, the physical category looks at movement competence, but also fitness and body composition. The scoring system may not be the most representative for determining physical literacy in

youth, due to body composition being a poor predictor of physical activity levels, thus this tool requires further evaluation. This tool was also used to assess children between 8-12 years of age which may not be appropriate for children that fall outside of this age range. The CAPL-2 is in the process of being created with aims to be a more concise evaluation tool, as well as, exclude some indicators that were not targeted to physical literacy, such as body composition. Passport for Life (Physical Health Education Canada 2013)[40] assesses physical education curriculum related to physical literacy: Active participation, Living and Personal Skills, Fitness and Movement Skills. This tool was developed for the education system and not for research purposes. The active participation, movement skills and personal and living skills components overlap physical literacy domains and can complicate the scoring results.

The PLAY tools are thought to capture physical literacy by looking at each domain independently. Other tools also look at domains, like fitness or movement skills, which are viewed as outcomes of physical literacy and not physical literacy itself.

1.4 Risk of Injury due to PA Participation

1.41 Musculoskeletal Injury

With an increase of physical activity participation comes the increased risk of musculoskeletal injury.[41, 42] In 2011, it was reported over 44 million children participated in sports annually.[41] Based on previous decade trends, that number of participants has only increased since 2011. The most commonly injured body parts were found in the lower extremity for all sports. The highest rates of injury in the emergency department (ED) for both male and female participants occurred in the 10 to 14-year- old category (male: 75 per 1000 and female: 36 per 1000 persons) with an

estimated 4.3 million nonfatal sport and recreation-related injuries in all age categories.[2]

Risk factors for injury can be categorized in modifiable or non-modifiable categories. Non-modifiable risk factors are characteristics such as age or sex. In order to change injury risk, most literature looks at addressing the modifying risk factors.[43-45] This includes biomechanical landing strategies, strength, balance, physical literacy and more. Neuromuscular control, or movement control, is changing drastically as adolescents progress through puberty. The cohesive communication within the body is usually analyzed in literature by looking at kinematics, kinetics and muscle activation. If there are alterations or abnormalities with kinematics, kinetics and muscle activation injuries can occur. Specifically, in youth, lower extremity biomechanics are looked at through landing tasks.[46] With the push for increased physical activity, solutions need to be established on identifying at-risk landing patterns. Once the landing patterns, or movement control, are understood in this age group, future interventions can be made more appropriately.

1.42 Screening Tools for Landing Strategies

Current literature looks at many methods for assessing lower extremity movement patterns. Much of the literature includes double leg jump landing, double leg squats and single leg squats. All of these tasks evaluate high-risk movement characteristics.[44] Prospective data has shown that biomechanics is altered after lower extremity injury.[45] This proves the need for biomechanical assessment to assess injury risk.

While lab-based assessments are able to control for many conflicts, there are challenges in assessing a large quantity of children in a reasonable time, as well as physically getting the children to the testing session. Field-testing eliminates the need for subjects to travel to testing and testing during school hours collects a captured audience. One common tool for capturing landing strategies is the landing error scoring system (LESS).[46, 47] This tool was validated for injury risk identification looking at youth soccer athletes by having them complete a jump-landing task. The sensitivity was reported at 86% and specificity at 64% for reporting anterior cruciate ligament (ACL) injuries.[47] There is also prospective evidence that using the LESS during a jump-landing task may predict lower extremity stress fractures.[48]

Utilizing the LESS during a jump-landing task can be completed in minimal time with minimal resources and cost. The use of a markerless motion capture system has also recently been used in the literature.[49] There is evidence to support the motion capture system is as reliable as an expert rater. Using a system rather than an expert scorer will reduce the time spent grading each jump. This test would be the most practical for a multi-facility study due to its ease of set up as well as the validity in youth participants.

1.5 Future Directions

Thus, the purpose of our study is to assess physical literacy scores and landing strategies in high-resourced and low-resourced communities. Our hypothesis is that physical literacy scores will be lower in the low-resourced community than the high-resourced community. We also hypothesize landing strategies will have more errors, or

be at more risk for lower extremity injury, in the low-resourced community than the high-resourced community.

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Chapter II

2.1 Introduction

The obesity epidemic is a serious public health concern with rates of obesity continuing to climb.[1] More recently, the obesity epidemic has spread to younger generations.[2] Many comorbidities are associated with obesity, including hypertension and type 2 diabetes.[1] While most of these comorbidities are usually only seen in adults, more and more children are developing risk factors for chronic diseases at a younger age.[3, 4] Children who are obese are likely to stay obese throughout adolescence and adulthood. The early arrival of these ailments will continue to increase the rise of healthcare costs in the youth population, which are already estimated to exceed $14 billion annually.[5, 6] Physical activity is an important part of maintaining a healthy lifestyle, especially starting at a young age. Childhood obesity is also indirectly affected by environmental factors, such as community and demographic characteristics.[7] For example, socioeconomic status (SES) influences physical activity participation in children; higher levels of activity have consistently been noted among high SES groups relative to lower SES groups.[8-11] Many external factors may influence lack of physical activity in low SES communities, such as neighborhood safety or access to safe recreation areas.

While physical activity interventions have been deemed ineffective in encouraging the longevity of physical activity, improving physical literacy may be key in being physically active throughout the lifespan[12, 13]. With physical literacy being a new concept in the United States, there are many accepted definitions in the literature. The International Physical Literacy Association (IPLA) defines physical literacy as “the

motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life".[14] The Aspen Institute and the Society of Health and Physical Educators (SHAPE), whose mission looks at physical education (PE) curriculum, has defined physical literacy as "the ability, confidence and desire to be physically active for life"[15, 16]. As seen with the previous definition, physical literacy is often grouped into three main pillars: physical ability, confidence and desire or motivation. There is evidence that shows internal factors affect physical activity, such as self-reported knowledge and confidence to participate in sport. [10, 17-20] A strong emphasis that physical literacy is more than movement skills will allow for future educators to focus on a combination of internal and external factors that may be holding children back from being physically active for life.

With the encouragement of physical activity in youth, the avoidance of musculoskeletal injury must also be considered. While musculoskeletal injuries, such as stress fractures and ACL sprains, are undesired consequences of physical activity in youth they are a reality.[21] Injury risk is multifactorial and evaluating movement control during sport-specific tasks, such as landing, can provide insight about an individual's risk of lower extremity injury. The Landing Error Scoring System (LESS) is a common screening tool that has been used to identify errors related to movement control and is a valid and reliable movement assessment.[22] A markerless motion capture system is also a reliable rater for movement errors and decreases time spent testing and evaluating trials.[23] Lack of neuromuscular control is a risk factor for injury[24-27]. Assessing fundamental movement skills through the PLAY fun tool can be used to look at neuromuscular control in any age group.[28] Prior evidence has explored

biomechanical changes in the body during puberty that warrant separation of elementary school and middle school children. This dichotomization is also clinically significant due to the separation of these age groups in many school communities.

Thus, the purpose of our study is to compare physical literacy scores (physical ability, confidence and motivation) and landing strategies between children of high-resourced and low-resourced communities in elementary and middle school. Understanding how fundamental movement skills and movement control vary between these populations can refine educational and practical approaches to improve overall physical literacy. Our hypotheses are that physical literacy scores will be lower in the low-resourced community than the high-resourced community and lower in the elementary school than the middle school. We also hypothesize landing strategies will have more errors, or be at more risk for lower extremity injury, in the low-resourced community than the high-resourced community and in elementary school children. This study will shed realistic light onto the differences in fundamental movement skills and movement control experienced between high-resourced and low-resourced communities and how that looks across two age groups.

2.2 Specific Aims

The overall purpose of this study was to compare physical literacy scores and movement control between children living in high-resourced and low-resourced communities. This study included two specific aims to achieve this. The first aim was to compare landing strategies and fundamental movement skills in high-resourced and low-resourced children in elementary and middle school. This was evaluated by the performance of the LESS and evaluated through a markerless motion capture system. Fundamental movement skills were calculated per task on a 100-point visual analog scale (VAS). The purpose of this aim was to see how the resources a community has affect the growth and development of children. The second aim looked to evaluate motivation and confidence in physical activity for children in high-resourced and low-resourced environments in elementary and middle school. The PLAY-self tool was used to assess confidence in participation, confidence in the performance of activities and perceived movement competence, confidence and enjoyment through a 13-item questionnaire. The purpose of this aim was to evaluate if confidence and motivation are different between children with varied resources.

2.3 Research Questions and Experimental Hypotheses:

2.31 <u>Manuscript 1:</u> Landing Strategies and Physical Ability between High-Resourced and Low-Resourced Children

Research Question:

Does movement and neuromuscular control, evaluated through LESS scores and 18 land-tasks on the PLAY fun tool, differ between children in a low-resourced community between children in a high-resourced community in both elementary and middle school?

Research Hypotheses:

- Children in low-resourced communities will have higher LESS scores, meaning their landings place them at a higher risk for lower extremity injury than children in high-resourced community.
- Children in low-resourced communities will have lower fundamental movement skills, meaning their neuromuscular control will be worse than children in high-resourced communities.
- Children in elementary school will have higher LESS scores, meaning their landings place them at a higher risk for lower extremity injury than children in middle school.
- Children in elementary school will have lower fundamental movement skills, meaning their neuromuscular control will be worse than children in middle school.

Statistical Analyses:

Two-way analysis of variance (ANOVA) will be used to evaluate an interaction between the type of environment and schooling group for average mean LESS

scores and fundamental movement skills. Main effects will also be assessed for type of environment and schooling group for both LESS scores and fundamental movement skills.

2.32 <u>Manuscript 2:</u> Physical Literacy in High-Resourced and Low-Resourced Children: Is Confidence and Motivation an Influencer?

Research Question:

Does confidence and motivation, evaluated through the PLAY-Self questionnaire, differ between children in a low-resourced community and high-resourced community in elementary and middle school?

Research Hypothesis:

- Children in low-resourced communities will be less confident and motivated than those in the high-resourced community.
- Children in middle school will be less confident and motivated than those in elementary school.

Statistical Analyses:

Chi squared analyses were performed on each individual question to determine if any significant differences existed between motivation and confidence in high-resourced and low-resourced groups by schooling level.

2.4 Independent Variables:

1. Environment:
    a. High-Resourced Environment (HIGH): Defined as schools that have greater than 50% of people that do not qualify for free or reduced lunch.
    b. Low-Resourced Environment (LOW): Defined as schools that have less than 50% of people that do not qualify for free or reduced lunch.
    c. Elementary School (ES): Defined as a self-reported grade of kindergarten through 4th grade.
    d. Middle School (MS): Defined as a self-reported grade of 5th through 8th grade.

2.5 Dependent Variables:

Movement Control

1. Landing Error Scoring System (LESS) Scores: Defined as the average total score, number of errors, over three successful trials.

Physical Ability

1. PLAY Fun (Appendix A)
    a. Locomotor – Defined as the measured score of continuous competence (0-100). The average of all locomotor tasks was assessed.
    b. Balance – Defined as the measured score of continuous competence (0-100). The average of all balance tasks was assessed.
    c. Upper Extremity Object Control – Defined as the measured score of continuous competence (0-100). The average of all upper extremity object control tasks was assessed.

d. Lower Extremity Object Control – Defined as the measured score of continuous competence (0-100). The average of all lower extremity object control tasks was assessed.

e. Running – Defined as the measured score of continuous competence (0-100). The average of all running tasks was assessed.

Motivation and Confidence

1. PLAY Self (Appendix B)
    a. Motivation – Questions 9,10,16 in the PLAY Self questionnaire with “Not true at all”, “Not really true” and “True” being counted as not motivated and “Very true” being counted as motivated.
    b. Confidence – Questions 7, 8, 11, 12, 14, 15, 17, 18 in the PLAY Self questionnaire with “Not true at all”, “Not really true” and “True” being counted as not motivated and “Very true” being counted as motivated.

2.6 Delimitations

- Children attended schools on the high end of high-resourced or the low end of low-resourced.
- Each group was powered well, decreasing variability within groups.

2.7 Limitations

- Wide age range may influence some results due to varying maturation stages of the participants
- Many evaluators were involved in data collection, which could show variability in grading strategies for physical ability competence.

- Testing also involved understanding the task that they were asked to do, language may have been an influencer of this.
- There are inevitable risks of questionnaire research, where answers may have been influenced by parents, peers, etc.

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Chapter III: Manuscript 1

Landing Strategies and Physical Ability between High-Resourced and Low-Resourced Children

3.1 Introduction:

Physical activity is an important factor in preventing obesity and optimizing health, specifically in children. The Centers for Disease Control and Prevention (CDC) recommends that children ages 6-17 years old complete 60 minutes of moderate to vigorous physical activity daily.[1] Much of the population is not achieving these levels of physical activity throughout the day with the World Health Organization (WHO)[2], National Strength and Conditioning Association (NSCA)[3] and the International Olympic Committee (IOC)[4] all highlighting that today's youth population as being alarmingly less physically active when compared to previous generations. Although numerous home- and school-based interventions aimed at improving physical activity levels have been attempted, the benefits of the intervention overall have poor retention in maintaining physical activity levels after the organized program is complete which calls into question the effectiveness of these programs.[5, 6] Alternative intervention initiatives to promote physical activity need to be considered since current approaches are not creating long-term improvements in physical activity levels. These alternative initiatives likely need to be multifactorial to address the many factors that impact physical activity in children.

Physical literacy is a growing concept in the United States, which is defined by the Aspen Institute as "the ability, confidence and desire to be active for life".[7] Fundamental movement skills reflect a child's ability, or competency, to participate in

sport. Fundamental movement skills include various gross motor skills, such as running, balancing, kicking, catching, striking, etc. Fundamental movement skills competency is associated with higher physical activity levels in children.[8] While increased physical activity levels is the goal of physical literacy, with participation comes the increased risk of musculoskeletal injuries.[9, 10] Primary prevention of musculoskeletal injuries also needs to be addressed with efforts to maximize long-term physical activity participation in children.

Musculoskeletal injuries, such as stress fractures and anterior c(ACL) sprains, are an undesired consequences of physical activity in youth.[9, 10] Injury risk appears multifactorial in youth athletes, but evaluating neuromuscular control during sport-specific tasks can provide insight about an individual's risk of injury.[11-13] There must be cooperation between muscles to produce a purposeful action, movement, or motor coordination successfully, and promote optimal joint loading.

Along with biomechanical risk factors for injury, socioeconomic status has also been linked to increased injury rates.[14, 15] Socioeconomic status (SES) is a factor external to the individual child and higher levels of activity have consistently been noted among high SES groups relative to lower SES groups.[16-19] Physical activity levels may be lower among children from low SES families due to parental choices and lifestyles, such as less leisure time, less knowledge of the benefits of exercise as a result of lower levels of education[19], and fewer financial resources to support children's activities. In addition, these factors associated with SES may be negatively impacting the development of appropriate neuromuscular control, associated with reduced injury risk, and the acquisition of fundamental movement skills. To the best of

our knowledge, there are no studies that have explored the associations between SES, fundamental movement skill competency and neuromuscular control measures associated with injury risk. Therefore, the purpose of our study was to evaluate landing strategies, as a metric of injury risk, and fundamental movement skills between high-resourced and low-resourced environments in both elementary and middle school children. We hypothesized that those in the low-resourced environment would demonstrate a greater at-risk landing strategy and be less competent with their fundamental movement skills. We also hypothesized that children in elementary school would have greater at-risk landing strategies and decreased fundamental movement skills than their middle school counterparts.

3.2 Methods:

3.21 Participants

A cross-sectional study design was used to assess healthy children who were enrolled in participating schools. Elementary and middle schools in XX were recruited to participate. Students at participating schools were subsequently recruited to complete a questionnaire and a single test session. Participants and their legal guardian completed informed consent and assent forms, respectively, which were approved by the university's Institutional Review Board prior to data collection. Participants were considered healthy if they were able to participate in their school's physical education class with no restrictions. Schools were dichotomized into high-resourced (HIGH) or low-resourced (LOW) based on the qualification of free or reduced lunch (Table 1).[20] Lunch assistance is calculated using the national poverty level. To qualify for free lunch, a student must fall below the poverty level multiplied by 1.30 and for reduced lunch, the

poverty level multiplied by 1.85. These numbers are updated each year and apply for the entirety of the following academic year. In the state of XX, each school posts the percentage of students that qualify for reduced or free lunch, which is easily assessable and public record. Those reports that showed 50% or greater of the school falling into the lunch assistance programs were considered low-resourced environments. Those reports that shower fewer than 49% of the school falling into the lunch assistance programs were considered high-resourced environments. Participants were also further divided into elementary school (ES)(Kindergarten-4th grade) or middle school (MS)(5th-8th grade) based on their self-reported grade.

3.22 Procedures

Anthropometric measurements of height and mass were completed. Students successfully completed 3 trials of a jump-landing movement after at least 1 practice trial. Participants jumped forward a distance of half their body height from a 30cm box and were instructed to complete a maximum vertical jump immediately upon landing. Participants needed to have (1) both feet leave the box at the same time; (2) perform a fluid jump *immediately* after the initial landing; and (3) jump horizontally, not vertically, during the forward jump.

As previously reported in methods by Mauntel et al[21], jump-landing trials were recorded in the frontal planes by a depth camera (frontal-plane view only; Kinect sensor, version 1; Microsoft Corp, Redmond, WA). The depth camera was controlled by a standard laptop with an Athletic Movement Assessment software (Physimax Technologies Ltd, Tel Aviv, Israel) used to evaluate the depth-camera data and score the Landing Error Scoring System (LESS).[21] The LESS is a valid and reliable clinical

screening tool[22] that has also been shown to be predictive of low risk of injury with scores under 5 in youth soccer athletes.[23]

The Physical Literacy Assessments of Youth (PLAY) tools were used to evaluate fundamental movement skill competency of each participant.[24] PLAY Fun assesses movement-based competence in 18 tasks representing 5 domains: Locomotor (LOCO), Balance (BAL), Upper Extremity Object Control (UE OBJ), Lower Extremity Object Control (LE OBJ) and Running (RUN). The PLAY Fun tool has demonstrated very good to excellent test-retest reliability (r=0.92), and very good inter-rater reliability using two-way mixed, consistency, average-measures ICC (ICC=0.89).[24]

3.23 Data Reduction and Analyses

The LESS was scored using a markerless motion capture software (PhysiMax Technologies Ltd, Tel Aviv, Israel). The average total score of 3 trials were used for data analyses. Each fundamental movement skill was scored on a 100mm scale and was measured for a score out of 100. The average composite score for each domain was used for data analyses (Table 2). Data analyses were accomplished using SPSS-Version 24 with an a-priori level of 0.05. Sex was considered a possible covariate but did not significantly impact any of the models, so sex was not incorporated into final analyses. Separate two-way analysis of variances were performed to determine if any significant differences existed in mean LESS scores and fundamental movement skill competency between high-resourced and low-resourced groups by schooling level (elementary, middle). Significant interactions were further evaluated by comparing 95% confidence intervals.

3.3 Results:

A total of 9 schools were willing to participate in this study. From these schools 443 children with their legal guardian provided assent and consent to participate in this study, respectively. Due to data collection occurring during the school day, not all children were able to complete the full test battery. Means and standard deviations for all dependent variables are displayed in Table 3. There was a statistically significant interaction between environment (HIGH, LOW) and school level (ES, MS) for LESS scores ($p=0.02$), Balance ($p=0.02$) and Running ($p<0.001$). In high-resourced environments, children in elementary school demonstrated more landing errors than children in middle school. Regardless of school level, participants in the low-resourced environment performed the locomotor ($p=0.001$), balance ($p=0.002$) upper extremity object control ($p=0.002$), lower extremity object control ($p<0.001$) and running ($p=0.04$) tasks with lower competency levels than participants from high-resourced environments. Regardless of environment, participants in middle school performed the LESS ($p=0.002$), locomotor ($p<0.001$), balance ($p<0.001$) upper extremity object control ($p<0.001$) and lower extremity object control ($p<0.001$) tasks with lower competency levels than participants from high-resourced environments. No other significant differences were observed ($p>0.05$).

3.4 Discussion:

Findings from this study reinforce the concern that children in low-resourced environments, specifically those in elementary school, may not have the neuromuscular control or fundamental movement skill competency needed to be active for life, which places them at risk of comorbidities associated with a sedentary lifestyle. To the best of our knowledge, this study is the first of its kind to explore the associations between

injury risk, fundamental movement skills and SES. In agreement with our hypotheses, strong focus should be placed on children who are at risk of decreased development in order to improve risk for underdevelopment. Children in schools with a low SES need to be aware of the risk of developing poor fundamental movement skills and increasing their risk of injury.

Clinically, evaluating movement control as an intermediate outcome for injury risk is widely accepted in literature[25], but has not yet been explored in relation to school SES' and school level. From these results, children attending school in high-resourced environments demonstrated better movement control compared to children in low-resourced environments. With movement control being a good predictor of injury, this places children in low-resourced environments with a higher risk of sustaining injury and becoming sedentary.

In addition to neuromuscular control, there were also differences in fundamental movement skills between each environment, with children in high-resourced environments performing better than children in low-resourced environments in all fundamental movement skills. Decreased fundamental movement skills in children in low-resourced environments could be due to lack of opportunity for participation in organized youth sport. Previous studies demonstrate that children with lower SES have decreased physical activity participation.[26] There are considerations, such as safety concerns in public parks, money for participation fees, travel costs and lack of health literacy in the household. With these factors, there may be further influence on the poor development of fundamental movement skills seen in the current study, and ultimately

contributing to sedentary lifestyles and growing obesity rates in this underserved population.[27]

Middle school children also demonstrated less movement errors, or had better movement control, than children in elementary school children. However, it is important to note that the average LESS scores for all children in this study were all above the number associated with lower risk of ACL injury[25], which demonstrates that all children have room to control improve their neuromuscular control. Much of the literature looks at athletic children with a mean age of ~13 years old, while this study also assessed movement control in elementary school children. Regardless of which environment, elementary school children demonstrated decreased fundamental movement skills than the middle school children. Although this is a cross-sectional study and are not able to observe the direct causal impact of maturation in these specific children, we can hypothesize that as children mature, they naturally improve in all aspects their physical ability. This could be due to exposure of different physical activities, expected pubertal changes, or improved understanding of the task being performed. One opposing result from our hypothesis was that children in the high-resourced elementary school were more proficient in running than high-resourced middle school children. This may be representative of effort in this population. Based on these results opportunity for participation as well as sport sampling should be explored in the future between these two communities.

As this is a large, field-based research study in the youth population, there are some inevitable limitations. Working with a youth population requires tasks to be simple enough so that children can understand what is being asked of them, but also complex

enough to assess what is needed. While this study is the first to look at LESS scores in the general population of elementary and middle school children, there is no normative data on movement control. Due to all groups falling above 5 errors, we are unsure if the last at hand is too challenging for these children.

In conclusion, this study supports our hypotheses that there are differences between high-resourced and low-resourced landing strategies and fundamental movement skills in both elementary and middle school. Future studies should look at other factors contributing to the discrepancies between environments.

3.5 Figures

	N	Sex	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)
	Elementary School					
HIGH	77	40M;36F	8±1	130±10	29±7	17±2
LOW	139	55M;60F	8±1	133±10	38±13	21±8
	Middle School					
HIGH	124	56M;67F	11±1	151±10	45±12	19±4
LOW	78	20M;40F	12±1	143±35	49±16	21±5

Table 1. Means and standard deviations of the subject groups.

PLAY Fun Assessment
Locomotor
I want you to perform crossover steps from this cone to the next.
I want you to skip step from this cone to the next.
I want you to gallop like a horse from this cone to the next.
I want you to hop on one leg from this cone to the next.
I want you to jump from this cone to the next.
Balance
I want you to walk forward “heal to toe” from one cone to the next while keeping your balance.
I want you to walk forward “toe to heal” from one cone to the next while keeping your balance.
I want you to drop to the ground and come right back up.
I want you to lift up the ball above your head and then lower it back down to the ground.
Upper Body Object Control
I want you to overhand throw the ball at the wall and make it bounce back over the top of your head.
I want you to strike the ball.
Lower Body Object Control
I want you to kick the ball at the wall.
I want you to dribble the ball as best you can.
Running
I want you to run in a square around the cones.
I want you to run a straight line to the cone, stop, turn around and run back.
I want you to run, jump at the cone and then land on two feet.

Table 2. Each task the children were asked to perform divided by each domain.

	LESS	LOCO	BAL	UEOC	LEOC	RUN
	Elementary School					
HIGH	8.2±0.3	64.8±12.3	62.7±12.3	66.7±17.2	63.8±19.4	76.2±16.7
LOW	7.8±0.2	63.0±71.8	61.7±15.0	57.6±17.5	46.9±20.1	61.2±19.1
	Middle School					
HIGH	6.9±0.2	78.4±10.7	80.0±10.5	71.5±19.0	71.0±21.9	67.7±19.4
LOW	7.7±0.2	71.8±10.8	72.5±11.3	68.2±19.0	61.9±23.0	74.4±13.6

Table 3. Means and standard deviations of all fundamental movement skill domains.

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Chapter IV: Manuscript 2

Socioeconomic Status Influences Physical Activity-Related Motivation and Confidence in Children

4.1 Introduction:

With the current obesity epidemic spreading to younger ages, increasing physical activity levels at an early age and through the lifespan is an important step to combat this growing problem. Currently, children are not reaching the recommended physical activity levels set forth by the Centers for Disease Control and Prevention (CDC) and appear to be significantly less physically active when compared to previous generations.[1-4] There are many factors that may influence activity levels in youth, including socioeconomic status (SES). Higher levels of activity have consistently been noted among high SES groups relative to lower SES groups.[5-8] Home- and school-based interventions aimed at improving physical activity levels have been attempted, the effectiveness of these physical activity interventions are still questioned as benefits are typically short-term.[9, 10] Many intervention programs focus on improving physical ability of children to perform skills, however, there may be psychological factors that should also be considered in order to truly improve physical activity participation.

Physical literacy is a growing concept in the United States, commonly broken into three pillars: ability, motivation and confidence.[11] When discussing physical literacy, motor competence is often primarily addressed,[10] however, physical literacy also includes the psychological domains of confidence and motivation. In order to be physically active, a child must *want* to be physically active. As a child, motivation, or desire, for physical activity participation comes mainly from peers and those around them.[12] A child's confidence in their physical ability will impact the longevity of their

physical activity participation[13]. Washburn et al reported that older children were able to accurately predict their motor competence in a set of tasks, proving that confidence is an important variable to consider when evaluating for physical literacy.[13] To the best of our knowledge there are no studies that have compared all aspects of physical literacy in children between high-resourced and low-resourced environments. Therefore, the purpose of our study was to evaluate confidence and motivation between high-resourced and low-resourced environments in both elementary and middle school children. We hypothesized that children in the low-resourced environment would demonstrate less confidence and motivation for physical activity. We also hypothesized that children in elementary school would present greater confidence and motivation for physical activity than their middle school counterparts.

4.2 Methods:

4.21 Participants

A cross-sectional study design was used to assess healthy children who were enrolled in participating schools. Elementary and middle schools in XX were recruited to participate by completing a questionnaire and single test session. Participants and their legal guardian completed informed consent and assent forms, respectively, which were approved by the university's Institutional Review Board prior to data collection. Schools were dichotomized into high-resourced (HIGH) or low-resourced (LOW) based on the qualification of free or reduced lunch (Table 1).[14] Lunch assistance is calculated using the national poverty level. To qualify for free lunch, a student must fall below the poverty level multiplied by 1.30 and for reduced lunch, the poverty level multiplied by 1.85. These numbers are updated each year and apply for the entirety of the following

academic year. Each school in XX posts the percentage of students that qualify for reduced or free lunch. Those reports that showed 50% or greater of the school falling into the lunch assistance programs were considered low-resourced environments. Those reports that show fewer than 49% of the school falling into the lunch assistance programs were considered high-resourced environments. Participants were also further classified as elementary school (ES)(Kindergarten-4th grade) or middle school (MS)(5th-8th grade) based on their self-reported grade.

4.22 Procedures

The Physical Literacy Assessments of Youth (PLAY) tools were used to assess physical literacy.[15] The PLAY Self tool consists of a 13-item questionnaire that assesses confidence in participation, confidence in the performance of activities and perceived movement competence, confidence and enjoyment (Figure 1). The PLAY Self test-retest reliability is very high (r=0.94) in grades 4 to 6, and in youth (grade 8, 10 and 12) (unpublished).[15] The questionnaire was completed by the child with a parent or adult caregiver.

4.23 Data Reduction and Analyses

To evaluate motivation, questions 9,10 and 16 on the PLAY Self tool were independently used for analyses. To evaluate confidence, questions 7, 8, 11, 12, 14, 15 17, and 18 on the PLAY Self tool were used from the PLAY Self questionnaire (Figure 1). Data analyses were accomplished using SPSS- Version 24 with an a-priori level of 0.05. Chi-squared tests of association were performed on each individual question to determine if any significant differences existed between motivation and confidence in high-resourced and low-resourced groups by schooling level. Each answer was coded

with, “not true at all”, “not usually true” and “true” being classified as not confident or motivated, and “very true” being classified as confident or motivated.

4.3 Results:

A total of 9 schools were willing to participate in this study. From these schools 443 children with their legal guardian provided assent and consent to participate in this study, respectively. Percentage of motivation and confidence between high and low-resourced environments are displayed in Figure 1 and 2. For elementary school children, there was a statistically significant association between environment (HIGH, LOW) and perception of skill (question 8) ($p=0.004$), importance of activity (question 9) ($p<0.001$), happiness with being active (question 10) ($p=0.001$), perception of their body allowing activity (question 12) ($p=0.01$), and understanding of directions (question 14) ($p=0.014$) with participants in HIGH environments reporting greater confidence and motivation than children in LOW environments. For middle school children, there was a statistically significant association between environment (HIGH, LOW) in eagerness to try new activities (question 16) ($p<0.001$), and the need to not practice skills (question 18) ($p=0.003$) with children in LOW environments reporting great confidence and motivation than children in HIGH environments. No other significant differences were observed ($p>0.05$).

4.4 Discussion:

To the best of our knowledge, this is the first study to evaluate motivation and confidence between high-resourced and low-resourced environments. High and low-resourced environments have previously been defined by household income status which may be considered private or personal information for these subjects. Findings

from this study reinforce the variability between confidence and motivation in sport between high and low-resourced environments. There is also a larger gradient between low-resourced elementary and middle school children than there is for the high-resourced children. In other words, children in elementary and middle schools within high-resourced environments appear similarly motivated and confident in sport in both elementary and middle school. However, children in low-resourced middle schools appeared more confident and motivated than elementary school children in low-resourced environments. Therefore, ES children in low-resourced communities demonstrated they are at the highest risk of being less motivated and confident in sport, which may cause physical inactivity in the future.

Based on these results, children appear more likely to be motivated than confident in sport regardless of school socioeconomic status. Clinically, this is valuable information to recognize because children may *want* to be physically active, but lack the confidence in their ability to be physically active. This difference should be emphasized in future physical activity initiatives, through free play and encouraging atmospheres. There is a strong focus in physical education on physical ability and the importance of exercise, which may contribute to motivation. However, there is a missing piece of how children become confidence when it comes to future physical activity participation. Currently, a meta-analysis assessed that physical activity intervention improved self-concept and self-worth in children and adolescents.[16]

There are inevitable limitations in this study which are acknowledged by the research team. The use of a survey, in any study, can create variability in the responses of children. Children were asked to either fill out the survey independently or with a

parent or caregiver which may have influenced their responses. Mood at the time of filling out the questionnaire may also have influenced response either positively or negatively. The variability of using a survey was accounted for by recruitment of many participants. There were some subjects who spoke English as a second language and may not have fully understood the questions being asked. This was addressed through the assistance of parents and caregivers providing support in answering these questions.

In conclusion, this study partially supports the hypotheses that low-resourced children overall were less motivated and confident in sport. There is discrepancy that elementary school children are less confident and motivated than middle school children. Future studies should look to see if addressing the psychological components of physical literacy improves physical activity participation in youth.

4.5 Figures

	N	Sex	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)
	Elementary School					
HIGH	77	40M;36F	8±1	130±10	29±7	17±2
LOW	139	55M;60F	8±1	133±10	38±13	21±8
	Middle School					
HIGH	124	56M;67F	11±1	151±10	45±12	19±4
LOW	78	20M;40F	12±1	143±35	49±16	21±5

Table 1. Means and standard deviations of the subject groups.

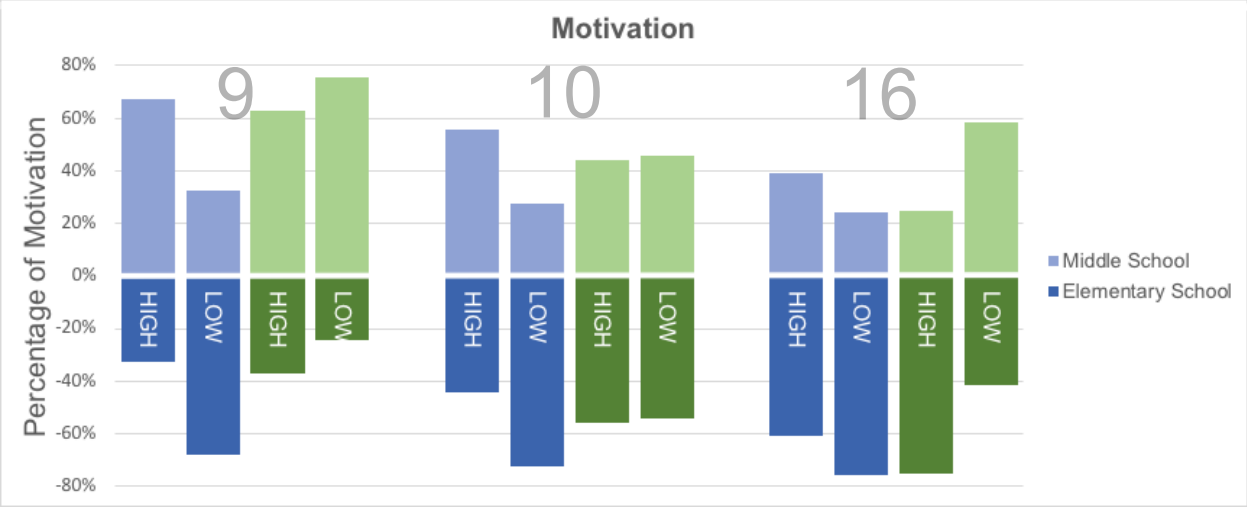

Figure 1. Percentage of motivation between high-resourced and low-resourced environments

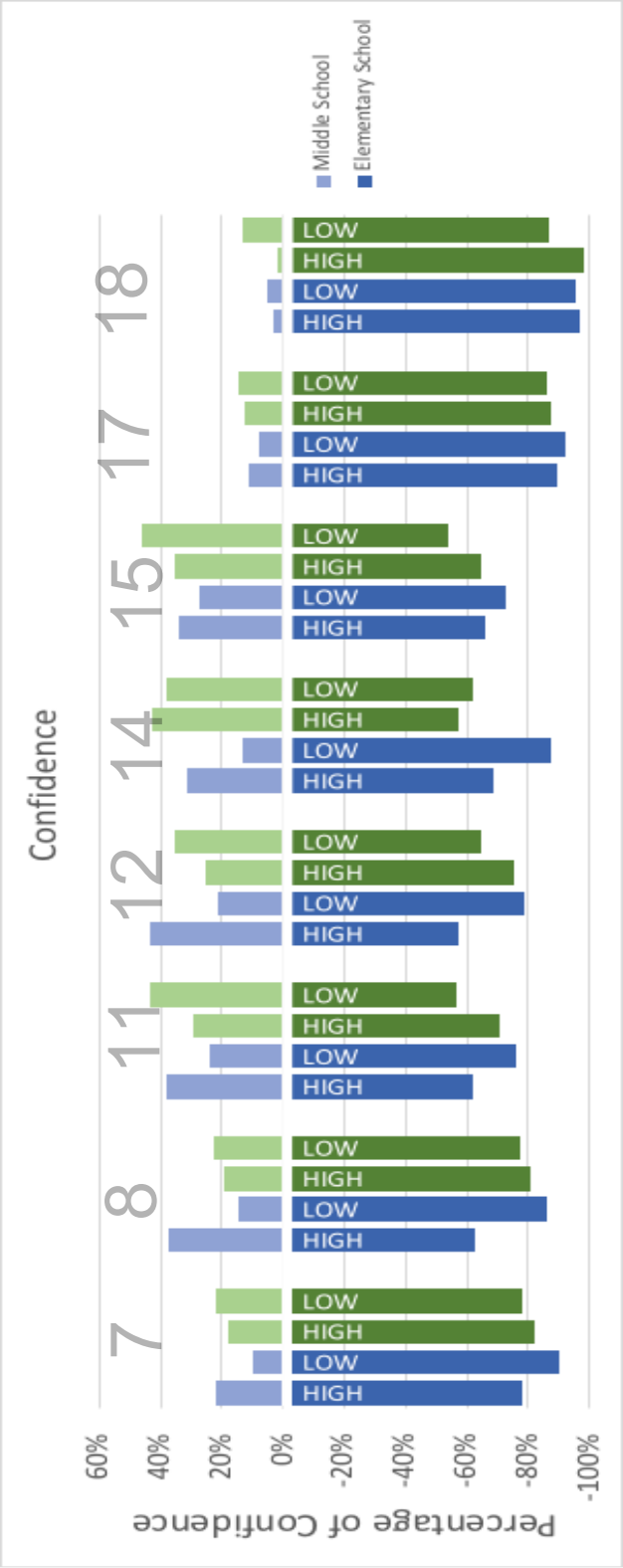

Figure 2. Percentage of confidence between high-resourced and low-resourced environments

PLAY-SELF Questionnaire				
7. It doesn't take me long to learn new skills, sports or activities.	NOT TRUE AT ALL	NOT USUALLY TRUE	TRUE	VERY TRUE
8. I think I have enough skills to participate in all the sports and activities I want.				
9. I think being active is important for my health and well-being				
10. I think being active makes me happier				
11. I think I can take part in any sport/physical activity that I choose				
12. My body allows me to participate in any activity that I choose				
14. I understand the words that coaches and PE teachers use				
15. I'm confident when doing physical activities				
16. I can't wait to try new activities				
17. I'm usually the best in my class at doing an activity				
18. I don't really need to practice my skills, I'm naturally good				

Table 2. PLAY Self questionnaire and associated responses.

4.6 References

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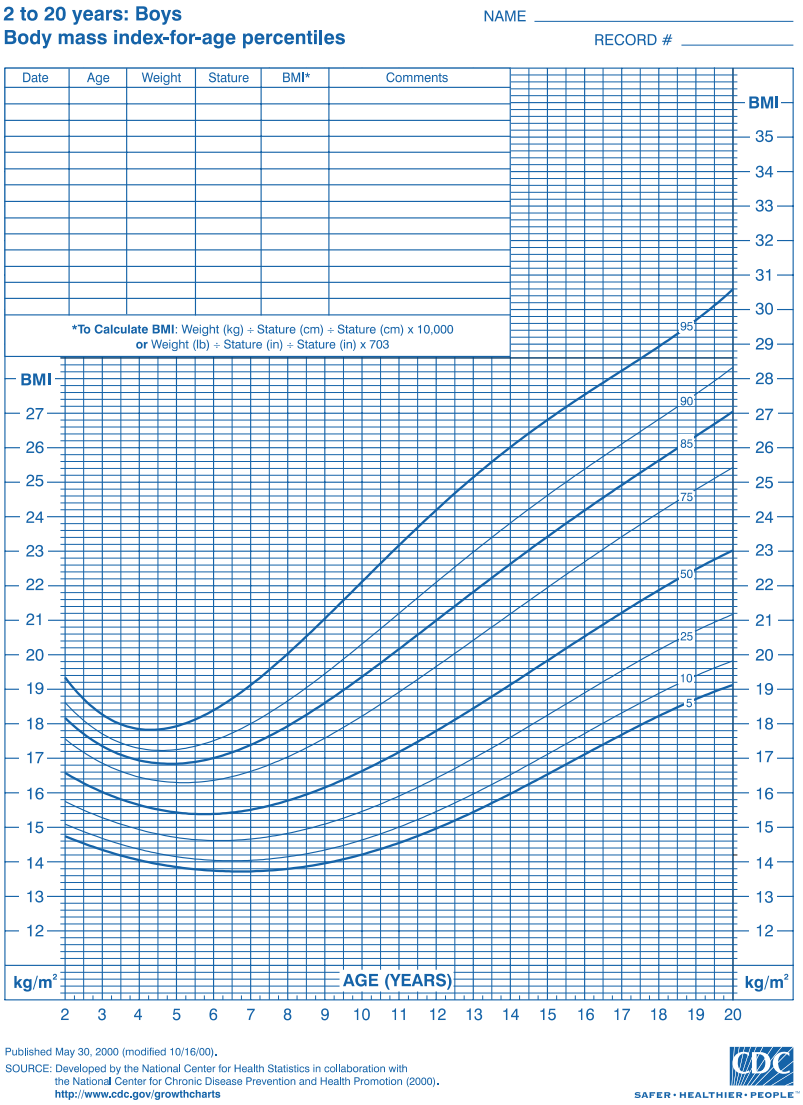
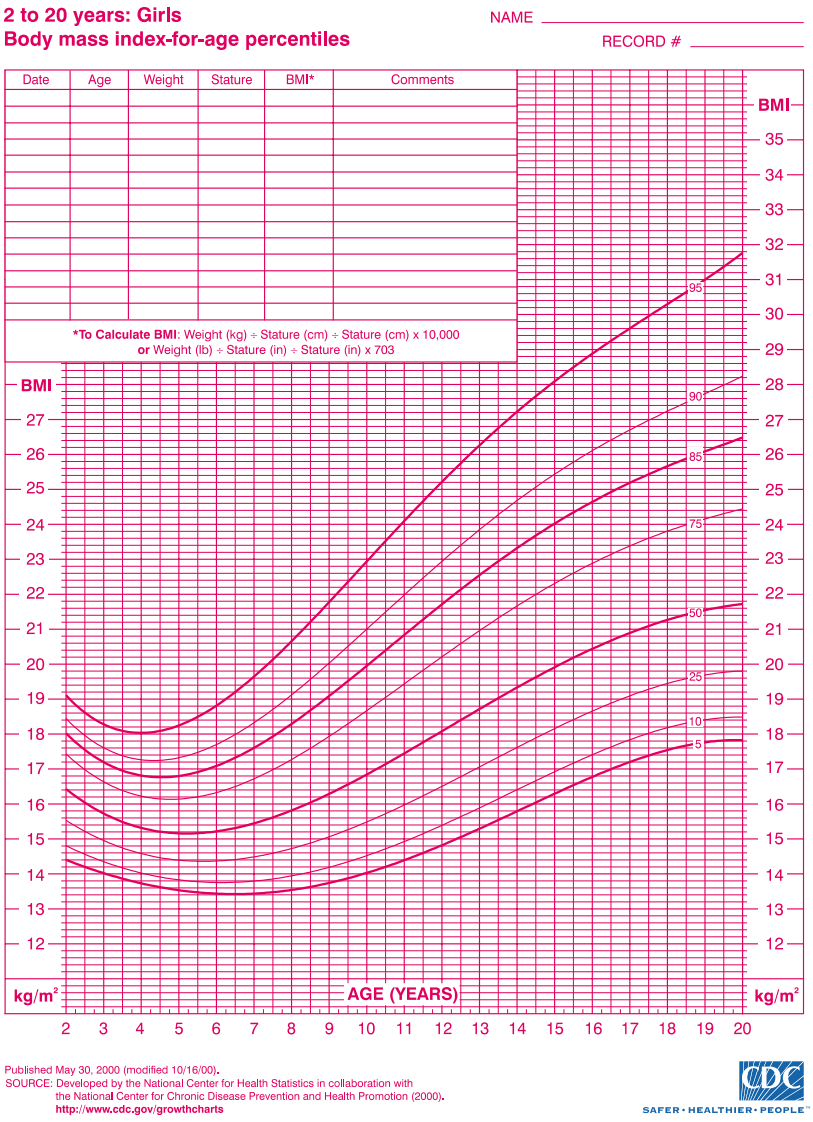
Appendix A: BMI chart for youth males



Appendix B: BMI Chart for youth females.



Appendix C.

PLAY Fun Assessment
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I want you to drop to the ground and come right back up.
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I want you to overhand throw the ball at the wall and make it bounce back over the top of your head.
I want you to strike the ball.
Lower Body Object Control
I want you to kick the ball at the wall.
I want you to dribble the ball as best you can.
Running
I want you to run in a square around the cones.
I want you to run a straight line to the cone, stop, turn around and run back.
I want you to run, jump at the cone and then land on two feet.

Appendix D.

PLAY-SELF Questionnaire				
7. It doesn't take me long to learn new skills, sports or activities.	NOT TRUE AT ALL	NOT USUALLY TRUE	TRUE	VERY TRUE
8. I think I have enough skills to participate in all the sports and activities I want.				
9. I think being active is important for my health and well-being				
10. I think being active makes me happier				
11. I think I can take part in any sport/physical activity that I choose				
12. My body allows me to participate in any activity that I choose				
14. I understand the words that coaches and PE teachers use				
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16. I can't wait to try new activities				
17. I'm usually the best in my class at doing an activity				
18. I don't really need to practice my skills, I'm naturally good				