Long Term Effects of a Physical Literacy Intervention Completed in Childhood

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Abstract for MSc

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Purpose: Physical literacy (PL) skills have been linked to the achievement of a healthy, and active lifestyle. PL programs can improve PL skills from pre to post intervention, but the long term improvements associated with a physical literacy intervention are unknown. **Methods:** Children from two schools who had previously participated in the Champions for Life (CFL) program were contacted. In total, 30 children completed the online questionnaires which included the knowledge and understanding and the motivation and confidence questionnaires from the Canadian Assessment of Physical Literacy-2 (CAPL-2), and the Physical Activity Questionnaire for Children (PAQ-C). The Child Focused Injury Risk Screening Tool (ChildFIRST) was used to assess movement competence on 45 children. **Results:** No difference was found in mean scores between the children who had participated and those who had not for the MC, the KU, the PAQ-C, and the ChildFIRST. A moderate correlation was determined between scores on the PAQ-C and MC but not between the PAQ-C and KU, nor the PAQ-C and the ChildFIRST. **Conclusion:** The results of this study suggests that a higher physical activity level in children is positively associated to their motivation and confidence they exhibit in their movements and physical activity. The results did not show that a physical literacy intervention had significant effects 4 years later on the children's motivation and confidence, knowledge and understanding, movement competence, and physical activity levels. More research is needed to truly examine the long-term effects of a physical literacy intervention.

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Introduction

Only 39% of 5-17 year olds are meeting the physical activity guidelines recommended in the Canadian 24-hour movement guidelines (participACTION, 2020). Physical activity is associated with physical and mental benefits such as better scores on cardiovascular health, bone health, indices of adiposity, cognitive development and brain health, academic achievement, and health related quality of life (participACTION, 2020). A study by the Canadian Society for Exercise Physiology looked at the direct health care expenditures and indirect costs of physical inactivity and obesity in Canada and determined that physical inactivity costs $5.3 billion and the costs associated with obesity were $3.7 billion (Katzmarzyk et al., 2004). An important concept when it comes to physical activity and keeping youth active is physical literacy (PL).

Physical Literacy

The concept of PL was put forward in 1993 by Margaret Whitehead, a leading researcher in PL (Whitehead, 2001). PL is defined as "the motivation, confidence, physical competence, knowledge and understanding to value and taking responsibility for engagement in physical activities for life" (Whitehead, 2013). The motivation and confidence refer to initiating movement and physical activity that can help improve quality of life (Whitehead, 2013). Children who are physically literate should move confidently with poise and coordination in a wide variety of situations (Whitehead, 2013).

The affective (motivation and confidence) domain refers to having enjoyment and enthusiasm for physical activity. It also includes the confidence to move in different physical environments such as on the ground, in and on the water, on snow and ice, and in the air (Mandigo, 2007). The physical competence domain includes foundation for movement skills and fundamental movement skills that include different intensities and movement for different lengths of time (Canada's Physical Literacy Consensus Statement, 2015). Fundamental movement skills can be categorized as locomotion, object control or balance skills. The cognitive aspect (knowledge and understanding) includes the ability to understand movement and the health benefits that being acting can bring (Canada's Physical LIteracy Consensus Statement, 2015).

Although the term has been around for almost 30 years, physical literacy is still in the early stages of its importance being understood and many argue that physical literacy should be given the same importance as literacy and numeracy (Edwards, 2016). The physical literacy "ABCS" are the 4 basic skills needed in physical literacy (Balyi, 2020). They correspond to agility, balance, coordination, and speed. Like letters in the alphabet, they are considered the building blocks to developing PL. These basics lay the groundwork for developing fundamental movement skills (FMS) such as running, jumping, hopping, throwing and catching. These FMS will significantly contribute to further athletic development in actual sports (Balyi, 2020).

Physical Literacy Assessments

There exist many tools to assess PL and they are classified as either product-oriented or process-oriented evaluations. Product-oriented tests look at the results of a movement (Logan, 2017). For example, how high someone can jump or how fast someone can accomplish a skill. Process based tools examine how a movement is performed (Logan, 2017), and take into account limb positions and joint angles. There are moderate to strong correlations between the process

and product-oriented assessments across skills such as the long jump, hop, and throw (Logan, 2017).

1. Test of Gross Motor Development (TGDM)

The Test of Gross Motor Development (TGDM) is a process-based assessment tool, meaning it uses qualitative aspects of movement skills to assess gross movement performance (Cools et al., 2009). It is designed for children aged 3 to 10 since this is the period where there is the most change in a child's gross movement skill development. The test has six locomotion skills (running, galloping, hopping, leaping, horizontal jumping, and sliding), as well as six object control skills (two-hand striking a stationary ball, stationary dribbling, catching, kicking, overhand throwing, and underhand rolling). It can be used to determine if a child is significantly behind their peers in their development of gross motor performances (Cools et al., 2009). The TGMD-3 evaluates fundamental motor skills that are divided into locomotor and ball skills. It consists of 13 fundamental motor skills that are observed and assessed by looking at three to five criteria per skill. There is also normative data collected from 2014 to 2017. The TGDM only evaluates the physical component of PL and is thus not an ideal tool to assess physical literacy as a whole.

2. Physical Literacy Assessment for Youth (PLAY)

The Physical Literacy Assessment for Youth (PLAY) tool is a series of PL tools designed to determine a child's physical literacy and assess all 4 components of PL. Designed by Sport for Life Society, it comprises six different sections: PLAYfun, PLAYbasic, PLAYself, PLAYparent, PLAYcoach, and PLAYinventory. The goal of PLAYfun is to assess 18 fundamental skills like running, throwing, and balance. PLAYbasic is similar to PLAYfun but it is a simpler version used to provide a snapshot of PL of the child being assessed. PLAYself is completed by the children or youth themselves to assess their own physical literacy. The PLAYparent, coach and inventory are used to supplement the skill assessments and are not skill assessments themselves. Cladwell et al., (2020) determined the intra-rater reliability for PLAYfun to be excellent (ICC=0.94) (Caldwell et al., 2020). They also saw that PLAYbasic was a significant predictor of PLAYfun. Overall the different PLAY tools, when used to assess school aged children, demonstrated strong inter-rater reliability, moderate associations with one another, acceptable internal consistency and good construct and convergent validity.

3. Canadian Assessment of Physical Literacy-2 (CAPL-2)

The CAPL-2 is a tool designed to assess physical literacy in children aged 8 to 12 years old. It is an extensive protocol that is a valid and reliable way to assess the components of PL (Longmuir et al., 2015). The CAPL has four components: physical competence, daily behavior, knowledge and understanding, and motivation and confidence. Lower scores on these components correspond with lower physical literacy. In 2018, Tremblay et al. collected data from 11 different sites across Canada and assessed the PL of over 10,000 school aged children (Tremblay et al., 2018). They calculated means and standard deviation for age and gender for all components of the CAPL. Total physical literacy scores out of 100 were averaged for boys and girls as well as total scores for each of the four domains for gender and age. The authors also performed analyses and calculated descriptive statistics for age and gender. Percentile distributions were also calculated for the physical literacy scores including domain and individual measurements (Tremblay, 2018). Based on the score the child got on overall PL or the individual components, the child would be in one of four categories; beginning, progressing, achieving, and excelling. Children who fall in the beginning category, under the 17th percentile, are just beginning their PL journey and have limited PL compared to peers of the same age. The

progressing category refers to children between the 17th and 65th percentile who are progressing in the PL journey and who are similar to the average peer in their age group. The achieving category is for children >65th to 85th percentile who meet the minimum level of PL recommended and are beginning to understand the health benefits of a physically active lifestyle. The excelling category is for children above the 85th percentile who are exceeding the minimum level recommended and who are excelling in their PL journey compared to children of the same age. The classifications of scores for the motivation and confidence and knowledge and understanding scores can be found in Appendix A.

The knowledge and understanding questionnaire in the CAPL-2 has five questions; the first four questions are multiple choice questions with four possible answers. These questions include topics like the recommended active minutes per day they should be getting. Definitions of cardiorespiratory fitness and muscular strength, and what should be done to get better at a skill. One point is awarded for each correct answer. The fifth question is a paragraph with blank spaces to insert words from the bank of words on the side. The children are awarded one point for every blank filled in for a total of six points.

The motivation and confidence questionnaire includes statements where the children choose how true that statement is for them. They are awarded 0.6, 1.2, 1.8 or 2.5 points depending on their answer. Some of the statements in this questionnaire include: Some kids really like playing active games, some kids are good at active games.

4. Child Focused Injury Risk Screening Tool (ChildFIRST)

The Child - Focused Injury Risk Screening Tool (ChildFIRST) is a process based assessment designed to evaluate movement competence and injury risk in children aged 8-12. It includes 10 movement skills: body weight squat, vertical jump, single-leg sideways hop and hold, walking lunge, horizontal jump, two-to-one-foot hop and hold, 90 degree hold and hold, leaping, running, and single-leg hop. Each skill is associated with four evaluation criteria. This process-based assessment tool has demonstrated moderate-to-excellent reliability (ICC=0.5-1.0) for all movements except for the two-to-one-foot hop and hold (Miller et al., 2020). It has also shown good-to-moderate (ICC= 0.5-0.75) intra-rater reliability for five movement skills (body weight squat, vertical jump, single-leg sideways hop and hold, walking lunge and horizontal jump) and poor (ICC= 0.00-0.5) intra-rater reliability for the other five movement skills (two-to-one-foot hop and hold, 90 degree hold and hold, leaping, running and single-leg hop). Since this assessment is process based it gives more information on how a movement is performed and will therefore give researchers and others more detail on skill execution (Hulteen et al., 2020).

Negative Effects of Lack of Physical Literacy

Whitehead believed that PL is important to a complete experience of human life (Whitehead, 2001). PL has been identified as a key factor in generating significant health benefits in both children and adults (Edwards et al., 2016). PL is associated with better health outcomes such as body composition, fitness, blood pressure (Edwards et al., 2016). The multifaceted concept of PL is an important determinant of health from a young age through adulthood (Caldwell et al., 2020). Children who are considered physically literate show the confidence to be physically active in a variety of environments such as land, snow, water, and ice (Belange et al., 2018). PL is considered a basic requirement for lifelong health benefits. It lays the groundwork for being physically active and participating in sports throughout the lifespan (Jefferies et al., 2019). It is therefore crucial that children have access to positive physical

experiences such as in physical literacy programs, so that they can develop an interest in being active and continue to do so throughout their life.

PL has also been associated with a child's confidence and competence to move (Jefferies et al., 2019). Although the mechanism between PL and confidence and motivation is not clear, it demonstrates that confidence and motivation developed through physical literacy can provide benefits beyond just the physical. PL can also help children develop the skills and abilities to navigate the social world. One of the benefits of physical literacy and physical activity is better overall mental health (Logan et al., 2019).

There have been several studies that have examined the link between BMI and weight and physical literacy. Participants of a healthy weight recorded higher physical literacy scores than those classified as overweight or obese (Comeau et al., 2017, Delisle et al., 2018, Holler et al., 2019). There is also an association between physical literacy and BMI; participants with higher BMI and greater waist circumference had significantly lower scores on the Canadian Assessment for Physical Literacy (CAPL-2) than participants with healthy BMI, weight and waist circumference (Delisle et al., 2018). A study by Holler et al. (2019) assessed the PL of adults using questionnaires covering 5 domains; physical activity, behavior, attitudes towards a physically active lifestyle, exercise motivation, knowledge, and self-confidence/self-efficacy. The authors observed that a holistic physical exercise intervention showed improvements in PL, physical activity behavior, and exercise self-confidence/self-efficacy (Holler et al., 2019).

Furthermore, they noticed a positive correlation with baseline BMI and physical exercise-induced improvements in the intervention group (Holler et al., 2019). There is a relationship between physical literacy and health. For example; BMI, waist circumference, body weight, grip strength, cardiorespiratory fitness were found to be predictors of physical literacy levels (Cornish et al., 2020). The direction of the relationship between physical literacy and health is unknown. It remains unclear if people who are healthier have higher levels of PL or if the opposite is true, and people who are more physically literate are healthier (Cornish et al., 2020).

The Canadian 24-hour Movement Guidelines for Children and Youth (ages 5-17) is a set of evidence based guidelines that should be adhered to within one complete day (CSEP, 2021). It involves components of physical activity, structured and unstructured play, sleep, and sedentary behavior. These guidelines recommend that children get at least 60 minutes per day of moderate to vigorous physical activity. Aerobic activities as well as muscle and bone strengthening activities should be incorporated at least 3 days per week. The guidelines also recommend several hours a day of both structured and unstructured play. Children between the ages of 5 and 13 years old should be getting 9 to 11 hours of uninterrupted sleep per night. They should also be limiting sitting for long periods and should not be using their screens recreationally for more than 2 hours a day.

Unfortunately, Canadian children are not meeting the PL minimum requirements. In 2018, Tremblay et al. used the CAPL and assessed the physical literacy of 10,034 Canadian children between the ages of 8 and 12 (Tremblay et al., 2018). Total physical literacy scores were scored on 100 and on average boys scored 63.01 ± 12 and girls scored 62.2 ± 11.3. Furthermore, less than 36% of children meet the minimum levels of physical literacy. These scores are not very high and resulted in participACTION giving Canadian children a physical literacy score of a D+ in 2019. A study by Belanger et al., (2018) revealed that only 20% of their participants were meeting the physical activity guidelines (Belanger et al., 2018). The authors also determined that those children meeting the guidelines had significantly higher physical competence, motivation, and confidence scores on the CAPL-2 than those who did not meet the

guidelines (Belanger et al., 2018). Similarly the children that followed the sedentary guidelines scored significantly higher on physical competence and motivation and confidence scores compared to those who were not meeting the sedentary time guidelines (Belanger et al., 2018). It is interesting to note that the knowledge and understanding of physical literacy scores are not associated with adherence to either the physical activity guidelines or the sedentary behavior guidelines (Belanger et al., 2018).

Another component of the lack of physical literacy in children may be attributed to the fact that 70% of children drop out of organized sport by the age of 13 (Logan et al., 2019). Although organized sport is important, unstructured play is also crucial in the development of PL. The Canadian Health Association defines unstructured play as a type of play where children can follow their own inspiration without a defined purpose or outcome (Canadian Public Health Association, 2019). Some skills like running, leaping, and climbing can be learned through unstructured play (Logan et al., 2019). Since children learn skills through active play and organized activity it is important that both be included in the physical literacy journey of a child (Logan et al., 2019).

Physically inactive children tend to replace exercise with screen time as they age (Faigenbaum et al, 2020). Children who aren't getting enough exercise need to be identified in their youth and be given exercise programs to target movement deficiencies and physical weakness (Myers et al., 2013). Youth need opportunities to increase their physical activity and to develop their physical literacy. Through access to activities and exercises children can develop their physical abilities and confidence which will provide an appreciation for PA throughout the lifespan (Faigenbaum et al, 2020). It is important to develop movement patterns in early life as children with movement deficiencies are less likely to continue doing physical activity later in life (Faigenbaum et al, 2020). In fact, one study showed that if girls do not become involved at a young age (<8 years old), they are less likely to become involved as they age (Howie et al., 2016).

Barriers to Physical Literacy

Many socio-economic barriers exist to becoming physically literate. A recent model, the Pediatric Inactivity Triad, describes 3 different factors that contribute to physical inactivity in youth (Faigenbaum et al, 2020). The factors that make up the triad include exercise deficit disorder (EDD), pediatric dynapenia (reduced muscular strength), and physical illiteracy. Exercise deficit disorder refers to <60 minutes of daily moderate to vigorous physical activity (Faigenbaum et al, 2020). Characteristics of dynapenia include low levels of muscular strength and power as well as limits to function that are not caused by neurologic or muscular disease (Faigenbaum et al, 2020). In fact, the youth of today seem to be weaker and slower compared to youth of previous generations (Cohen et al., 2011, Runhaar et al., 2010, Laurson et al.,2016). The third concept of the pediatric inactivity triad is physical illiteracy. The pediatric inactivity triad contributes to the rising number of inactive youth and can lead to significant health deficits in children and adolescents. Without guidance from family, community, peers and qualified professionals, it is not likely that youth who are physically illiterate will become more physically active later in life (Caldwell et al, 2020). Physical literacy programs in schools, after school activities, and in communities may help break down these barriers. Encouraging children to become more physically literate and showing them fun games and activities where they develop

skills, and the motivation and confidence to be physically active for life, is key in breaking the cycle of inactivity in children.

Implementing Physical Literacy

Recently, many organizations and sectors in Canada are seeing the importance of physical literacy and implementing it into their programs, practices, policies and research (Tremblay et al., 2018). It is being used increasingly in physical education, sport participation, and in the promotion of physical activity (Edwards et al., 2017). One of the ways to increase physical activity in youth is through afterschool programs (Bremer et al., 2020). A study by Bremer et al, examined the feasibility and outcomes of a 12-week physical literacy intervention for children in an afterschool program. They assessed children's physical literacy using the Physical Literacy Assessment for Youth (PLAY) tool. Their intervention was targeted to not only improve motor skills, but also improve motivation and confidence. The study determined that a 12-week afterschool program was feasible for non-experts to deliver and it can help improve the four aspects of physical literacy in children (Bremer et al., 2020).

Another way to implement PL programs is through the school curriculum. Since youth spend a great deal of their time in school, this may be the ideal setting to develop their physical literacy (Logan et al., 2019). A school in Europe tested the theory out during the 2014/2015 school year on students in grades 1 to 4 (Demetriou et al., 2018). The students completed a sports-oriented curriculum which included daily 90-min physical education lessons, active recess opportunities, and non-sport subjects were taught in an active way. The motor performance and fundamental motor skills of the children were evaluated. The researchers then compared the PL scores from the sport oriented school to students from a regular primary school. They observed that the children in the sports-oriented school had a significantly more positive attitude towards physical activity than those in the control school (Demetriou et al., 2018).

It is important that PL intervention programs not only be easy to implement but also provide the children with an appropriate amount of challenge. Engaging the children in properly challenging activities can lead to improved basic movement competence but also the confidence and competence to use these movements in different physical and social environments (Jefferies et al., 2019).

PL Intervention Programs & Their Effects

The short term effects of a physical literacy intervention have been seen through pre- and post-intervention studies. As stated above, the Bremer et al. study determined that a PL program in an afterschool setting can lead to improvements in the affective domains of PL in children. They also determined that a comprehensive PL program done after school is feasible to implement. The Bremer et al. study suggests that a PL program completed after school may be an effective way of increasing PL and it’s associated benefits in children. A study by Coyne et al. (2019), investigated if a FMS program delivered to children in grade 4-6 could increase PL and showed similar results to the Bremer et al. (2020) study. The program called Run Jump Throw Wheel, was delivered for 10 weeks during the physical education class of 310 students. They used the CAPL-2 tool to assess the physical literacy of the children. The authors saw that the program increased the participants' overall FMS as well as their knowledge and understanding of these FMS (Coyne et al., 2019). Belanger et al. (2016), also demonstrated that an intervention

could improve physical literacy. Although this study was done with preschoolers, the researchers showed that the Healthy Start-Depart Santé intervention leads to improvements in PL in this younger age group. The Healthy Start-Depart Santé consists of enabling families and educators to integrate physical activity and healthy eating by working on factors in the intrapersonal, interpersonal, organizational, community, physical environment, and policy levels. The physical literacy and gross motor skills of the children were measured using the Test of Gross Motor Development (TGMD-2).

The Learning for Life intervention which was delivered to 126 children in grades 4-7, was shown to improve digital health literacy over the short term and also helped the children learn and retain healthy lifestyle and knowledge behaviors (Hyman et al., 2020). The study also retested the students 2 months after the intervention. The authors reported that the students' digital health literacy decreased from post-intervention to follow-up 2 months later.

A meta-analysis by Logan et al. (2011), examined 11 studies on children and adults that implemented a motor skill intervention, pre and post qualitative assessment of FMS, and availability of means and standard deviation of motor performance. The authors noted significant improvements in FMS competence post-intervention as measured by the TGMD-2. Interventions improved scores in both object control and locomotor skills (Logan et al., 2011).

Although these studies were done on different age groups using different physical literacy assessment tools, they all show that PL and physical activity interventions can improve the PL of its participants post-intervention and in the short term. The question remains, however, if a physical literacy intervention program can have lasting benefits on the PL of the children who participated in a PL program.

Champions for Life

The Champions for Life Foundation, based in Montreal, Canada, has a physical literacy program designed for children ages 5-8 years old. The goal of the physical literacy program is to help children learn fundamental movement skills so that they can build their confidence and competence in skills like running, jumping, balancing, kicking, and throwing. The program is usually 20 weeks long and consists of four modules each containing five- 30 minute sessions that are broken up into challenges, demonstrations, practice, and fun games. The challenge stations are 3 zones where kids practice one of the three categories of movements. For example, one section would be holding a pose for 3, 5, and then 10 seconds. Another section would be throwing a bean bag to a target, 5, 7, and 10 meters aways. The final section would be galloping with one leg forward for 10, 15, and 20 meters. The demonstrations and practice part consists of the leader demonstrating a new movement and going over the 4 cues associated with it. The kids then get to practice this new movement and focus on correctly doing the 4 cues. The final part of the class is spent doing a game that involves the new movement skills. Some of the skills included in the 20 week program are: skipping, galloping, jogging, running, hopping, jumping, multiple balance poses, dynamic balance poses, dribbling with feet and hands, underhand ring toss, underhand throw, overhand throw, and disk toss.

In 2016/17 a study (DeMont, unpublished) was completed to assess the CFL program and determine its effects on the children who participated in it. Approximately 90 children were split into two groups; a control group that performed after school activities with no focus on physical literacy and an intervention group that took part in the Champions for Life physical literacy intervention. They were quasi randomized by class into one of the two groups. The children

participated in their assigned activities for 10 weeks. The children's physical component of physical literacy was assessed both pre- and post-intervention using 12 tasks; kicking a ball, underhand catching of a ball, overhead throwing of a ball, horizontal jump (from 2 feet to two feet), hopping (one foot), hand dribbling a ball, overhead squat with a stick overhead, one foot landing, single leg balance/standing, push up, sprint running, and skipping (step-hop). The study concluded that the intervention group improved more (average 30%) compared to the control group (average 10%) in their physical capability. Specific skills improved more than others; the single leg balance skill improved in 46% of children in the program group, but only 33% in the control group; airplane balance skill had an improvement of 52% versus 36% in the control (DeMont, unpublished). In the locomotion category skipping improved 54% in the program versus 40% in the control, running improved 37% in the program group but only 27% in the control group, single leg hop showed a 66% increase versus 30% for the control group (DeMont, unpublished). In the object manipulation category the underhand catch improved by 36% in the program group and 30% in the control group (DeMont, unpublished). However, some skills improved more in the control group than the program group; for the horizontal jump the control group improved by 42% versus the program group (35%) and the underhand throw improved by 46% in the program group and 50% improvement in the control group (DeMont, unpublished). In conclusion, all the skills except for underhand throws and the horizontal jump showed more improvement in the program group compared to the control group.

Rationale and Objectives

Our question was to determine if children aged 11-12 who participated in a PL intervention 4 years ago, will have better current PL scores compared to children who did not participate in the program. We wanted to determine the lasting effects of a PL program, specifically improvements associated with the Champions for Life 10-week program.

Regular physical activity is recommended for children and adolescents and sets the basis for them achieving and maintaining a healthy lifestyle (Belange et al., 2018). Proficient physical literacy skills have been linked to the achievement of a healthy, active lifestyle, and meeting PA and sedentary behavior guidelines (Belange et al., 2018). As mentioned above, only a small percentage of children are meeting the recommended guidelines, this further demonstrates the need for interventions to promote active lifestyles in children (Demetriou et al., 2018).

There is quantitative evidence that motor skills and PL interventions can improve FMS competence in children (Logan et al., 2011) and that PL programs can improve PL skills from pre- to post-intervention. Afterschool PL intervention programs have short-term benefits of increased health-related fitness and PA levels in youth (Bremer et al., 2020). The skills acquired during these programs can have a positive effect on children later on in life as well. A clinical report by Logan et al. (2019) found that motor skills acquired during preschool and elementary school can positively influence long term participation in organized sports, physical activity and cardiovascular health (Logan et al., 2019). However, the long-term improvements associated with these programs are anecdotal. PL scores can be improved by participating in a PL program or intervention, but the potential long-term benefit from these programs remains unclear.

Hypothesis

Our aim was to determine if a PL intervention done in childhood (age 5-8) can lead to improvements in PL and physical activity levels in the subsequent 3-5 years. We hypothesized that the children who completed the Champions for Life physical literacy program would have higher scores on the knowledge and understanding, and the motivation and confidence components of the CAPL-2. We also predicted that they would do better than the control group on the ChildFIRST and score higher on the PAQ-C. We also hypothesized that those children who are more physically active and score higher on the PAQ-C would have better PL scores on both the CAPL-2 and the ChildFIRST.

Methods

Ethics approval (certificate #30015357) for this study was obtained from Concordia University Human Research Ethics Committee.

Study Design

This cohort study examined the long-term effects of a physical literacy intervention program from Champions for Life. We assessed the physical literacy of the children from the previous study through various questionnaires and tools. We compared the scores between children who participated in the intervention and those who did not, and determined correlations between physical activity and PL scores.

Participants

The participants were children who previously participated in a control group study examining the immediate effects of the Champions for Life Physical Literacy Program and their peers who did not participate. The previous study had 146 children recruited from elementary after-school programs in and around the Montreal area. When they first completed the study these children were in kindergarten, grade 1 and grade 2. The children in grade 1 and grade 2 have now moved on to highschool and were not able to be tracked down for follow-up. The kindergarten children, now 11 and 12 years old, were contacted through the elementary schools where they did the PL program.

Measures

Physical Literacy Assessment

The physical literacy of the children was assessed with the ChildFIRST and 2 questionnaires from the CAPL-2. The ChildFIRST was used to assess the physical component of physical literacy whereas the motivation and confidence, and knowledge and understanding questionnaires were used from the CAPL-2. The children's physical activity was assessed using the PAQ-C. Both the CAPL-2 questionnaires and the PAQ-C were put onto LimeSurvey and the link was sent to the parent's of the children through the schools.

1. ChildFIRST

The ChildFIRST was used to assess the movement competence of the children. It contains 10 movement skills: body weight squat, vertical jump, single-leg sideways hop and hold, walking lunge, horizontal jump, two-to-one-foot hop and hold, 90 degree hold and hold, leaping, running and single-leg hop. Each movement had 4 criteria and the children were given a point for each criteria done correctly. The total score available for the ChildFIRST is 40. A description of the 10 skills can be found in Appendix B and the four grading criteria for each skill can be found in Appendix C.

2. Confidence and Motivation & Knowledge and Understanding

The CAPL-2 has multiple components but only two questionnaires from it were used to assess the children's physical literacy and looked at their knowledge and understanding, and confidence and motivation in their ability to be physically active. Each child completed the CAPL-2 questionnaires with the help of a parent or teacher. The knowledge and understanding

questionnaire was scored out of 10 points. The knowledge and understanding questions can be found in Appendix D and the scoring in Appendix E. The knowledge and understanding component of the CAPL-2 has shown good validity and feasibility (Tremblay et al., 2018). The test-retest reliability was substantial to excellent for 71% of comparisons over a 2 day interval (Longmuir et al., 2018) The motivation and confidence questions were scored out of 30 points. The questions can be found in Appendix F and the scoring in Appendix G. The motivation and confidence questionnaires from the CAPL-2 have shown good test-retest reliability and predictive validity (Tremblay et al., 2018).

3. Physical Activity Questionnaire for Children (PAQ-C)

The children also completed a physical activity questionnaire describing the physical activity and sports they have been doing during the past 7 days. The PAQ-C is a "self-administered, 7 day recall questionnaire that measures general moderate to vigorous physical activity during the school year" (Kowalski et al., 2004). There are 9 questions each scored on a 5-point scale. The total was given as the average on the questions /5. The physical activity questionnaire has shown consistently high validity and moderate reliability (Richardson et al., 2011). The questions of the PAQ- C can be found in Appendix H.

Procedure

The two schools where children participated in the CFL program, Children's World Academy and St. Edmund, were contacted by email with information. Both schools sent out the study information, consent forms, and the questionnaires to the parents and then collected hard copies of the signed forms.

Due to the lack of children completing the questionnaires with their parents, CWA had a computer lab open to the children. All the children who consented were then able to complete the online questionnaires with the help of their teachers. St. Edmunds school only sent out the questionnaires to the parents and were not able to complete the questionnaires with the students in person.

The evaluators all completed the training in the use of the ChildFIRST. Both schools had the evaluators come into the school to complete the ChildFIRST. They were blinded to the groups of the children. The gyms were set up with 5 different stations. There was one evaluator at each station who was responsible for assessing two movement skills from the ChildFIRST. The children were split into small groups of 4-5 children and each group started at a different station. Once all the children in the group had completed the two movements they moved to the next station and the next evaluator. This was continued until the children had completed all 5 stations and all 10 movements of the ChildFIRST.

The motivation and confidence survey, knowledge and understanding survey and the PAQ-C were all put onto LimeSurvey and the link was given to the parents and teachers. Age, weight, height and BMI were collected from the online questionnaires. The results from the surveys were exported in a comma - separated values (cvs) file. The data was then all compiled into one excel sheet and then exported to SPSS (version 27). Means ± standard deviation were calculated for the control and intervention group on all the questionnaires and the ChildFIRST. The data from the ChildFIRST assessment was manually entered into an excel spreadsheet, where previous participation in the CFL was identified as 1 and no previous participation was identified as 0. The data set was then exported to SPSS (version 27).

Statistical Analysis

In this study, the group assignment (intervention group and control group) were the independent variables. The dependent variables were the childrens' scores on the different components of the PL (motivation and confidence and knowledge and understanding) assessment, the PAQ-C questionnaire, and the ChildFIRST scores.

Although the data was normality distributed for each category, non-parametric tests were used because of the discrepancy in group size. The means from the questionnaires and the ChildFIRST were compared using the Mann Whitney U tests. Spearman Correlation was used to determine the relationship between scores of the questionnaires and physical activity levels. The correlation scores were calculated between PAQ-C and the ChildFIRST, PAQ-C and KU, as well as PAQ-C and MC. All statistical analysis was done through SPSS version 27 with a significance set at $p \leq 0.05$ for all tests.

Results

There were 45 children who completed the ChildFIRST; 18 participated in the CFL, and 27 did not participate. There were 30 children who completed the online questionnaires; 10 of them participated in the CFL program and 20 did not. There was no difference in demographics (age, height, weight, BMI) between the two groups (Table 1).

Difference in Mean Scores

There was no significant difference in means for the motivation and confidence scores ($U = 137.5$, $p = 0.100$); the mean motivation and confidence score for children who had participated was 24.51 ± 6.60 and for those who had not participated was 22.23 ± 4.29 (Graph 1). There was no significant difference in means on the knowledge and understanding scores ($U = 75$, $p = 0.286$); for the children who had participated the mean was 7.40 ± 2.17 and for the children who had not participated was 8.35 ± 1.46 (Graph 2). There was no significant difference in scores on the PAQ-C questionnaires ($U = 107$, $p = 0.779$); the mean PAQ-C score for the children who had participated was 3.11 ± 1.03 and for children who had not participated was 3.11 ± 0.76 (Graph 3).There were no significant differences in total scores on the ChildFIRST ($U = 192.5$, $p = 0.241$); the mean ChildFIRST score for the children who had participated was 28.50 ± 5.09 and for those who had not previously participated the mean score of 30.26 ± 5.38. See graph 4 for more information. There was a significant difference in mean scores on the leaping skill of the childFIRST ($U = 139.5$, $p=0.032$); the mean for the children who had participated was 1.67 ± 1.113 and for those that had not was 2.50 ± 1.225. The remaining skills (horizontal jump, single leg sideways hope and hold, two-to-one foot hop and hold, running, vertical jump, walking lunge, single leg hop, bodyweight squat, 90-degree hop and hold) were not significantly different (Table 2).

Correlation between PAQ-C, the Questionnaires, and ChildFIRST

There was a significant moderate correlation between PAQ-C and motivation and confidence with a correlation coefficient of $\rho=0.43$ and a significance of $p=0.009$. The correlation between the PAQ-C and knowledge and understanding was not significant with a correlation value of $\rho=0.23$ with a significance of $p=0.114$. The correlation between the PAQ-C and the ChildFIRST was not significant and had a correlation value of $\rho=-0.08$ with a significance of $p=0.344$.

Discussion

Difference in Mean Scores

In our study we aimed to determine if children who had participated in a PL program 4 years ago would have higher physical literacy skills than those who had not participated. We also aimed to determine if there is a correlation between the amount of physical activity and scores on the different components of PL. It was hypothesized that the children who had participated in the Champions for Life program would demonstrate higher motivation and confidence, higher knowledge and understanding, and higher ChildFIRST scores. We also expected the CFL group to be more physically active as assessed by the PAQ-C. The results of this study did not show that a physical literacy intervention had any long term positive results on physical literacy. There was no significant difference in any of the scores between the children who had completed the CFL physical literacy intervention and those that did not participate.

Most of the research done on physical literacy interventions have done pre and post PL testing, and to our knowledge none have completed a follow up evaluation in the years following. Bremer et al (2020), assessed the PL levels through the PLAY tools both pre and post 12 week intervention and found an increase in motor competence, self-efficacy and motivation in the children who completed the intervention. Another study by Coyne et al (2019) found that the 10 week program of Run Jump Throw Wheel increased FMS as well as the knowledge and understanding scores from the CAPL-2. A study done on children in Hong Kong included pre and post intervention testing as well as three month follow up (Li et al, 2022). They noticed that physical competence and knowledge and understanding were still significantly higher in the children who had sit-stand desks and a play based recess (activities led by physical activity teachers) compared to a play based recess alone and a control group with no structured activities during recess. In fact, improvements in PL can be seen in as short as a 4-week intervention (Mendoza - Munoz et al., 2022). After a 4 week program of active breaks that contained games designed to improve motivation and confidence as well as motor skills, children increased their scores on the CAPL-2 in the domains of physical competence, motivation and confidence, knowledge and understanding, but not in the daily activity domain (Mendoza-Munoz et al, 2022). As seen in the literature, PL programs can increase PL in the short term, but our results did not show that these associations last in the long term. We found no difference in scores on any of the questionnaires or the ChildFIRST between the children who had completed the physical literacy program and those that had not participated. Even between the different skills of the ChildFIRST there was no significant difference except for the leaping score in which case the children who had not previously participated did better than those that had participated. This result is hard to explain.Perhaps the 10 children who had participated just did not leap well; maybe because they don't participate in activities that require leaping. Leaping is a skill that may be used less often than some of the other skills like running and jumping. Perhaps the lack of difference in the scores may result because four years is too large of a time frame to have completed the follow up. Ideally, a follow up would have been done at 1-, 2-, 3-, and 4-year intervals and this may have given us different results or at least shown us a trend for when the benefits of a PL program tend to weaken. It is also possible that a 10-week physical literacy program is not sufficient to instill long term PL improvements. Maybe with more constant or longer interventions we would have seen more long term benefits. More research is needed on the long term effects and benefits of physical literacy interventions.

Association Between PAQ-C and Physical Literacy

Based on the literature it was hypothesized that there would be a correlation between physical activity and the scores on the different questionnaires. Our results indicate a moderate correlation between the PAQ-C and motivation and confidence scores. These findings further support the concept that participating in more physical activity will lead to more confidence and motivation and/or vice versa, but we did not determine a directional influence. This result is similar to Bremer et al 2020 whose findings suggest a 12 week PL program can lead to a significant increase in enjoyment in physical activity and sports. Another study by Brown et al (May 2020) studied students in grade 5 and categorized them into 3 main levels of physical literacy and then compared their physical activity levels. The low PL were children who had consistently low scores on the subdomains of PL. The moderate PL group consisted of children who had consistently moderate scores across the subdomains of PL. The high PL group was defined by consistently high scores in the subdomains of PL. They noticed that students that fell into their high physical literacy category were also more physically active. The children who fell into the moderate PL category were the next physically active followed by the low physical literacy group.

Despite the motivation and confidence scores being correlated with physical activity, we did not find a correlation between knowledge and understanding and physical activity. The literature is in agreement with what was seen in our study. Belanger assessed 2956 children using the CAPL-2, and determined that children with higher scores on motor assessments also had higher scores on motivation and confidence and were more likely to meet the Canadian PA guidelines (Belanger et al., 2020). However there was no link with the knowledge and understanding scores and amount of physical activity. This suggests that more focus should be on the motivation and confidence components of PL programming compared to the knowledge and understanding domain.

Developing PL early on can lead to better physical and emotional health (McDaid, 2016) FMS need to be learned, practiced, and reinforced (Logan et al., 2011) PL interventions give children the opportunity to learn, practice, and develop their gross motor skills.

Stodden also believed that the relationship between physical activity and a child's motor skill competence would strengthen over time (Stodden et al., 2008). Future work needs to be done to better promote physical literacy and physical activity to have good programs available for children and promote a healthy, active life.

Many studies group PL together as a whole to look at the association between PL and physical activity (Caldwell, et al 2020). Our study broke down the physical literacy domains and examined their individual associations with physical activity levels. By breaking down the different components of PL we hoped to gain a better understanding of the different components of PL and their effects on PA levels. Our study used 3 different tests (ChildFIRST, CAPL-2 and PAQ-C) which makes it difficult to compare our results to those in the literature. In previous studies PL has been evaluated using one or two assessment tools, and then the total score is compared to PA levels. However, it is interesting to break down the components of PL and examine them individually and perhaps this gives a more complete picture of physical literacy.

Limitations

The results of our study are in disaccord with much of the previous research on the topic. There are several limitations to our research project that could potentially account for the discrepancy between the literature and our study. The first is the relatively small sample size. Due to Covid and other factors only 45 out of the original 146 were able to be contacted for the follow up study. Additionally, the participants may have been less active for the past two years (Houser et al, 2022). To our knowledge, there is no previous literature that has looked at the long term effects of a PL intervention with a pandemic occurring throughout. We did not take into account the activities or sedentary time of the children throughout the pandemic and this could impact the current PL and physical activity levels of the children. Perhaps some children had more opportunities to be active than others.

Furthermore, out of the 45 children only 30 of them completed both the ChildFIRST and the online questionnaires. CWA was able to open up a computer lab to the children and have them complete the questionnaires with their teachers. However, St. Edmunds only sent out the questionnaires to the parents and were unable to send follow up reminders or complete the questionnaires with the children. This created a low number of children who completed the questionnaires. There was also a large difference in group sizes between the children who had previously completed the CFL program and those who had not. For the questionnaires, only 10 children had completed the intervention while 20 children had not. For the ChildFIRST assessment, only 18 children had participated in the program and 27 had not. Although non-parametric testing was used to try and eliminate some of the discrepancy it would have been ideal to have a more even distribution in each group along with a larger participant pool.

It is also important to note that the children completed the Champions for Life program four years ago. A lot can happen in four years including the children participating in other physical literacy programs. We did not take into account if the children had participated in another physical literacy program. We also did not look at the amount of physical activity the children got throughout the pandemic which according to Houser et al. is less than pre pandemic standards (Houser et al.2022). These factors could all play a role in the current physical literacy levels of the children.

Although the results of this study were disappointing, there are many reasons for the null findings. The research done in the literature uses a huge variety of tests and tools to assess physical literacy and physical activity levels. It is difficult to draw conclusions when different tests are being used to assess. We recommend that future research and testing be done, using standardized assessments, on the long term effects of physical literacy programs to truly analyze the effects a physical literacy intervention can have on children in the years following the program. A lot of the studies also adjusted for socioeconomic status which is something that we did not do but that plays a huge role in physical activity levels and PL. Making healthy lifestyle choices (which tend to be more expensive) is more difficult for those with a low socioeconomic status and this has a direct impact on PL.

Conclusion

Developing physical literacy skills early on in children can lead to better physical and emotional health and these effects can eventually be passed down to future generations (McDaid, 2016). Logan et al. (2011) suggests that children do not develop FMS naturally and these movements need to be learned, practiced, and reinforced so the child can obtain the positive health related outcomes related to these FMS (Logan et al., 2011). Gagen & Getchell (2006) indicate that although free play helps encourage movement, it doesn't contribute directly to the learning of FMS and conclude that physical literacy programs are needed to teach children these skills (Gagen & Getchell, 2006). Physical literacy interventions give children the opportunity to learn, practice, and develop their gross motor skills as well as the affective domains of PL (Logan et al., 2019).

However, the results of our study demonstrated a limitation to long term benefits of the Champions for Life physical literacy program but showed that there is a correlation between physical activity and motivation and confidence. More research on the long term effects of a physical literacy intervention are needed to determine benefits of PL programming. Regardless, as Logan 2019 states physical activity is important for physical health as well as emotional, social, and psychological health and PL scores can be improved by participating in a PL program or intervention.

Graphs & Tables

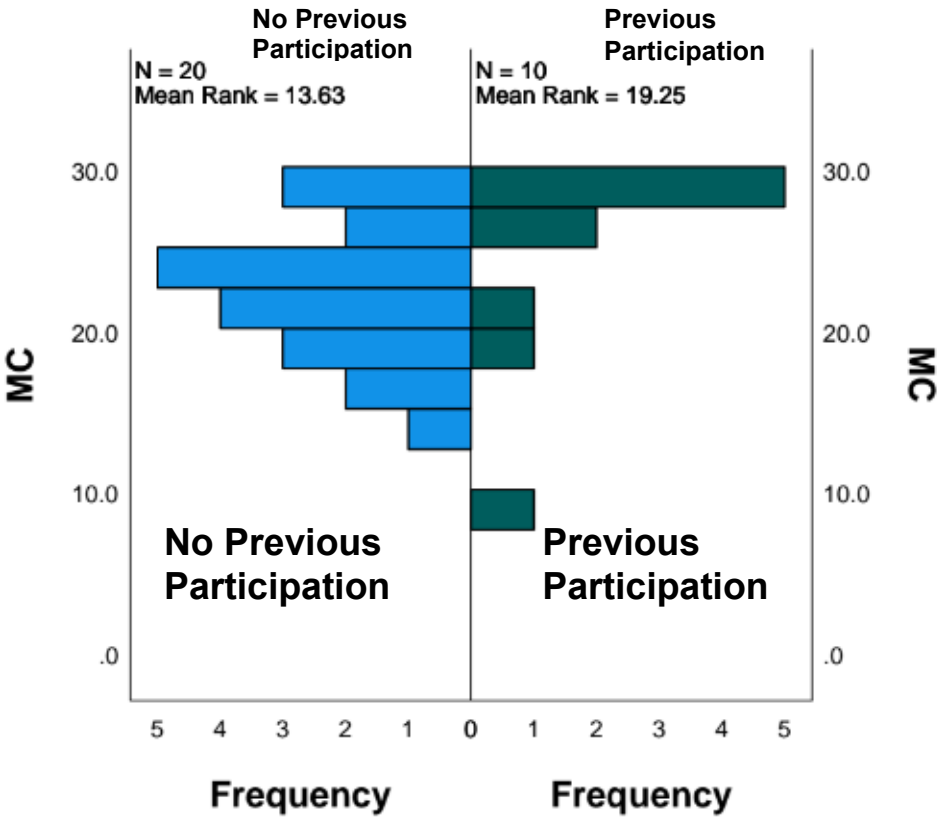
Table 1: Demographics for Questionnaire Participants

	No Previous Participation	Previous Participation	T-Test Significance
Number of Children	20	10	-
Age (years)	11.6	11.8	0.13
Height (m)	1.56 ± 0.076	1.57±. 011	0.619
Weight (kg)	44.425 ± 7.746	44.01 ±5.28	0.262
BMI($\boldsymbol{kg/m^2}$)	18.28 ± 2.50	18.56 ± 3.73	0.072

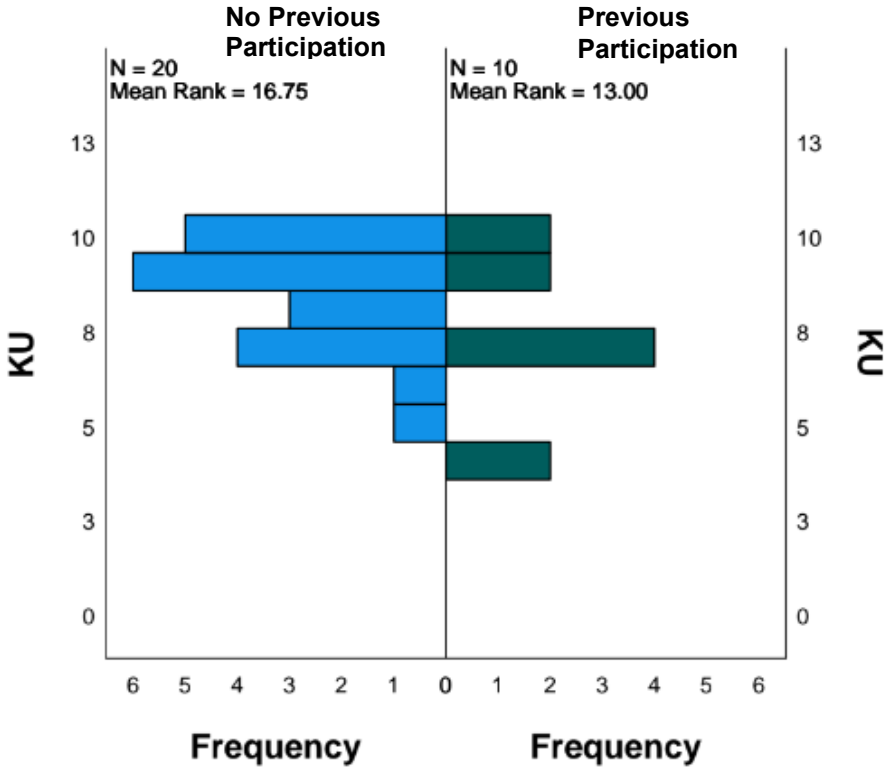
Table 2: Difference in Scores on the ChildFIRST Skills

Skill	Mann-Whitney U value (significance)	No Previous Participation	Previous Participation
Leaping	139.5 p=0.032*	2.50±1.225	1.67±1.113
Horizontal Jump	212.5 p=.749	2.86±1.279	3±.756
Single Leg Sideways Hop and Hold	217.5 p=0.846	2.80±.714	3±.926
Two-to-one Foot Hop and Hold	243.00 p=.645	2.63±.964	2.80±.775
Running	180 p=.206	3.6±.675	3.4±.632
Vertical Jump	236.50 p=.766	3.17±.874	3.27±.799
Walking Lunge	264.00 p=.317	2.90±.923	3.2±.77
Single Leg Hop	246.00 p=.564	2.80±.714	2.93±.594
Bodyweight Squat	171.5 p=.175	3.10±.960	2.73±.884
90-Degree Hop and Hold	250 p=.518	3.10±.759	3.13±1.125
Total ChildFIRST Scores	192.5 p =0.241	30.26 ± 5.38	28.50±5.09

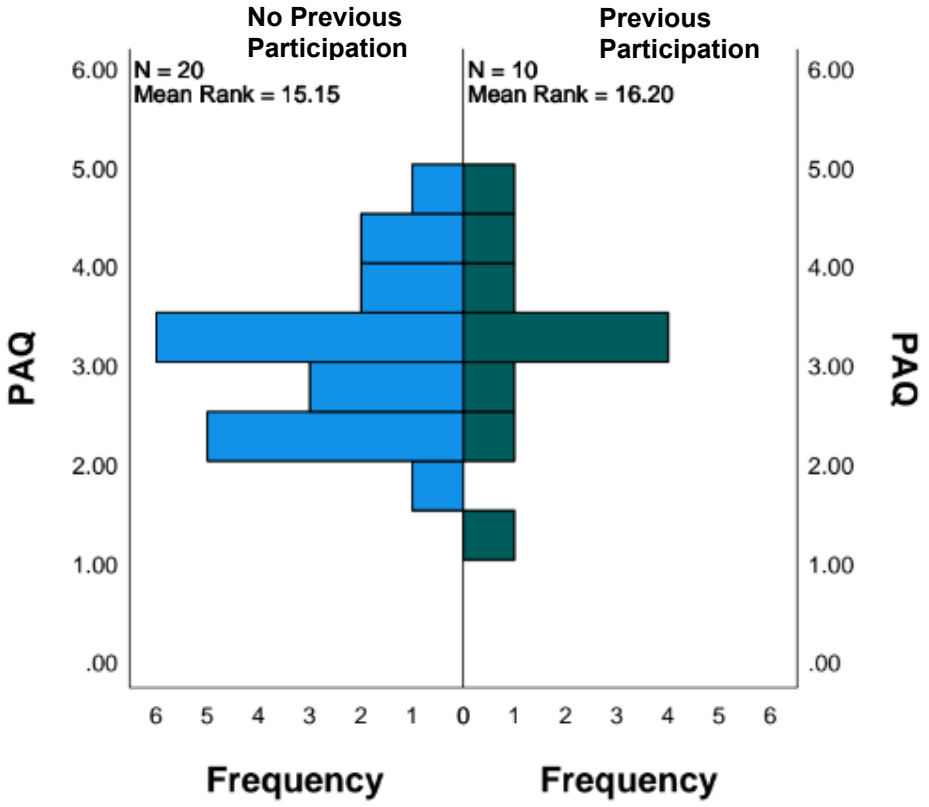
Graph 1: Motivation and Confidence Bar Graph



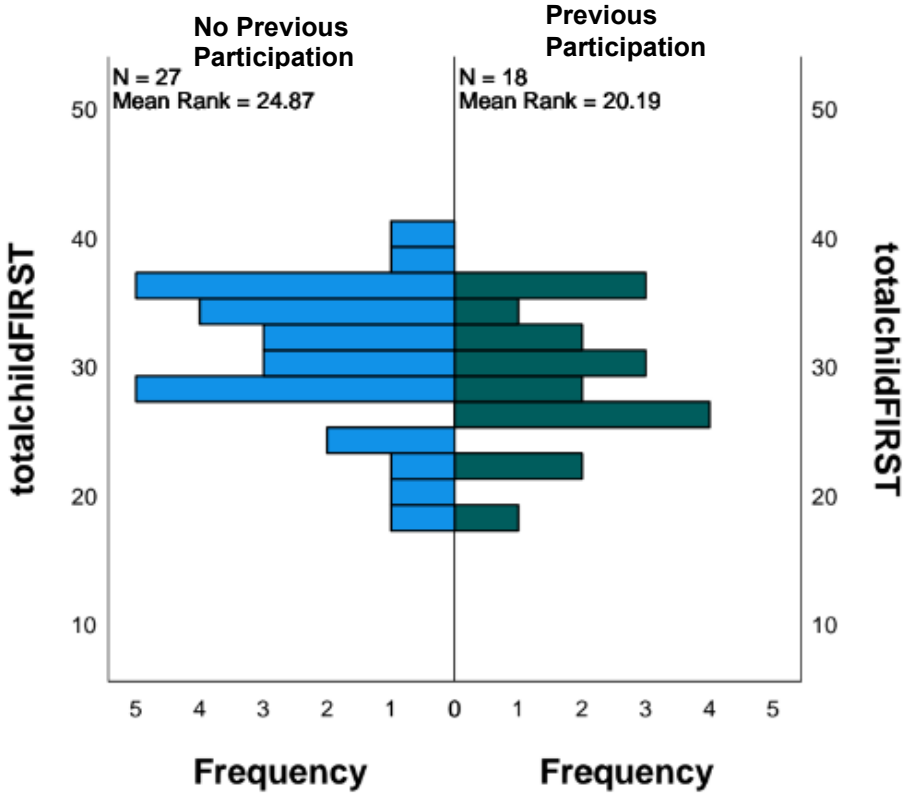
Graph 2: Knowledge and Understanding Bar Graph



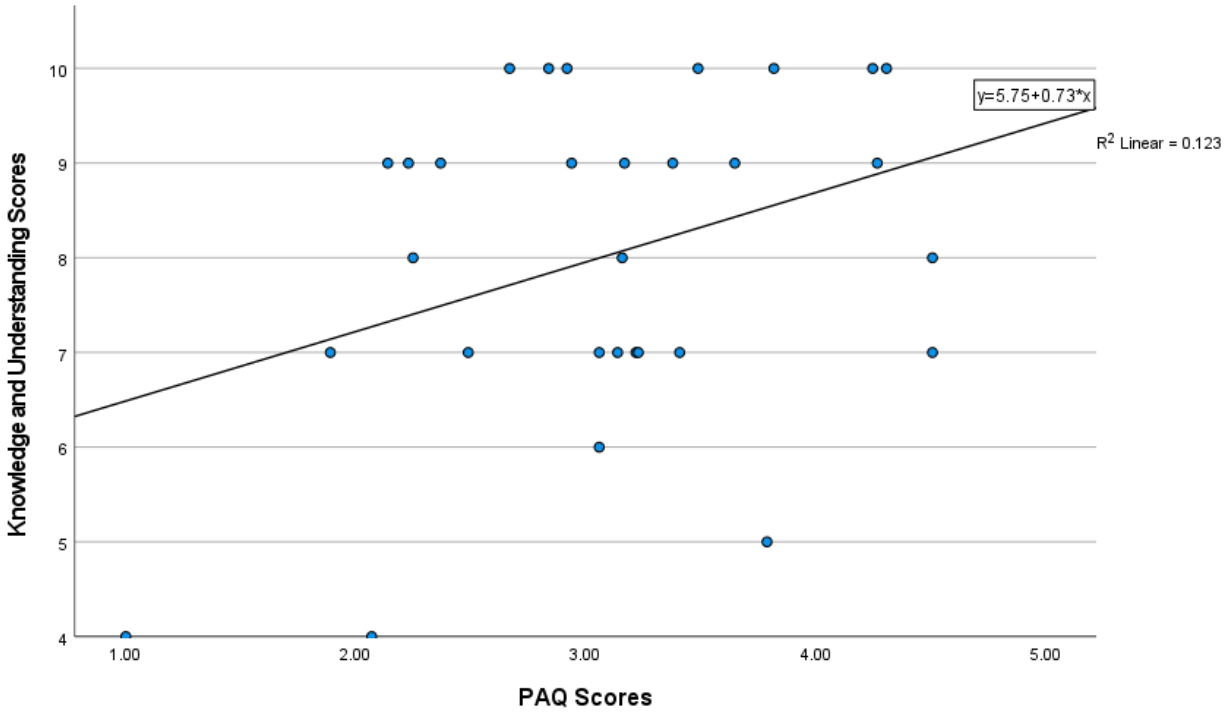
Graph 3: Physical Activity Questionnaire Bar Graph



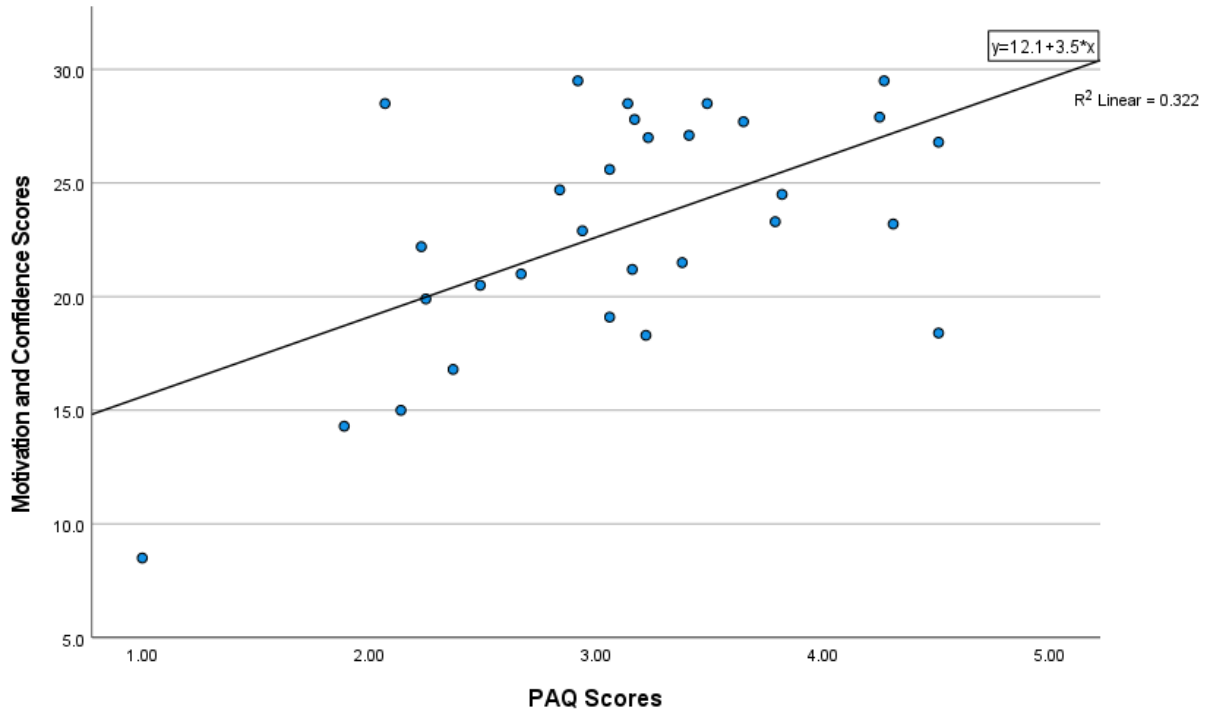
Graph 4: ChildFIRST Bar Graph



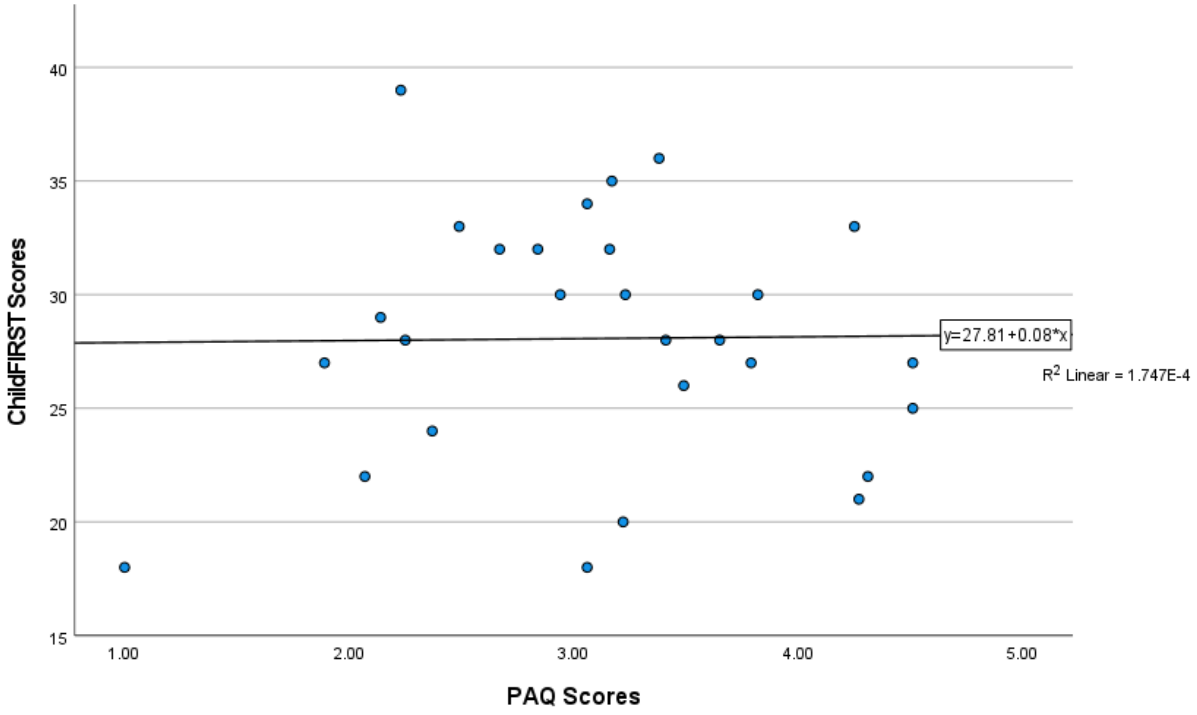
Graph 5: Correlation for Knowledge and Understanding vs PAQ



Graph 6: Correlation for Motivation and Confidence vs PAQ



Graph 7: Correlation for ChildFIRST vs PAQ



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Appendix

Appendix A1: Interpreting Motivation and Confidence Domain Score (CAPL-2)

	Beginning	Progressing	Achieving	Excelling
Girls				
8 years	<16.2	16.2 to 22.3	22.4 to 24.8	> 24.8
9 years	<16.2	16.2 to 22.5	22.6 to 24.8	> 24.8
10 years	<16.2	16.2 to 22.5	22.6 to 24.8	> 24.8
11 years	<16.2	16.2 to 22.5	22.6 to 25.0	> 25.0
12 years	< 16.3	16.3 to 22.5	22.6 to 25.0	> 25.0
Boys				
8 years	< 16.3	16.3 to 23.0	23.1 to 25.3	> 25.3
9 years	< 16.7	16.7 to 23.3	23.4 to 25.7	> 25.7
10 years	< 16.8	16.8 to 23.5	23.6 to 26.0	> 26.0
11 years	< 16.8	16.8 to 23.7	23.8 to 26.0	> 26.0
12 years	< 16.8	16.8 to 23.7	23.8 to 26.2	> 26.2

**Based on data collected on >10,000 Canadian children

A2: Interpreting Knowledge and Understanding Questionnaire (CAPL - 2)

	Beginning	Progressing	Achieving	Excelling
Girls				
8 years	< 4.8	4.8 to 6.6	6.7 to 7.3	> 7.3
9 years	< 5.0	5.0 to 6.9	7.0 to 7.7	> 7.7
10 years	< 5.3	5.3 to 7.3	7.4 to 8.1	> 8.1
11 years	< 5.5	5.5 to 7.6	7.7 to 8.4	> 8.4
12 years	< 5.6	5.6 to 7.8	7.9 to 8.6	> 8.6
Boys				
8 years	< 4.4	4.4 to 6.4	6.5 to 7.2	> 7.2
9 years	< 4.7	4.7 to 6.8	6.9 to 7.6	> 7.6
10 years	< 5.0	5.0 to 7.2	7.3 to 8.1	> 8.1
11 years	< 5.2	5.2 to 7.5	7.6 to 8.4	> 8.4
12 years	< 5.3	5.3 to 7.6	7.7 to 8.5	> 8.5

**Based on data collected on >10,000 Canadian children

Appendix B: ChildFIRST Skill Description

Skill	**Description**
Body weight squat	Squatting involves flexing the knees and hips allowing the hips to move back while lowering the center of gravity. The feet are a comfortable distance apart and the hands are placed either crossed on the chest or extended out in front of the body. The movement should be smooth, and the child will have three trials.
Single leg hop	Single-Leg Hop is performed by small forward jumps taking off from one foot and landing on the same foot. The movement should be smooth, and performed equally on both sides. Single-Leg Hop will be evaluated on a 10-meter space marked by cones, and the child will have two trials on each side.
Running	Running is faster than walking, but it is not sprinting. It will present the pattern of heel strike-midfoot-forefoot and a flight phase. The movement should be smooth. Running will be evaluated over 20 meters marked by cones where the child will run and come back.
Vertical jump	Vertical jump is the action of propelling the body up into the air from the ground using both legs and landing with both feet. The child will have three trials.
Horizontal jump	Horizontal jump is the action of propelling the body forward using both legs and landing with both feet. The child will have three trials.

Skill	Description
Walking lunge	The lunge is a movement where the child takes an extended step forward and bends both the front and back legs to approximately 90 degrees. The front foot should be flat on the floor and the child should continue this movement over the 10-meter space, alternating legs with each step. The movement should be smooth, performed equally on both sides, and the child will have three trials.
Two to one foot hop and hold	Two to One-foot Hop and Hold is a movement where the child starts with feet a comfortable distance apart, hops forward, and lands on one foot. The child tries to recover balance after landing, and maintains the position. The child will have two trials on each side.
Single Leg Sideways Hop and Hold	Single-Leg Sideways Hop and Hold is a movement where the child starts in a single leg stance, hops laterally and lands on one foot. The child tries to recover balance after landing, and maintains the position. The child will have two trials on each side.
Leaping	Leaping is the action of propelling the body forward and is performed by taking off on one foot and landing on the other foot. The movement should be smooth, and performed equally on both sides. Leaping will be evaluated on a 10-meter space marked by cones, and the child will have two trials.

Appendix C: ChildFIRST Criteria

Movement	**Criteria 1**	**Criteria 2**	**Criteria 3**	**Criteria 4**
Body Weight Squat	Push hips back and bend knees until the thighs are approximately parallel with the ground	Hips, knees and ankles aligned	Knees do not go too far in front of the toes	Keep the heels down all the time
Walking Lunge	Hips, knees and ankles aligned	Upper body straight and eyes focused in direction of travel	Front knee does not go too far in front of the toes	No twisting or back bending
Leaping	Take off from one foot, land on the opposite foot	Knees and hips bend softly in a controlled fashion	Hips, knees and ankles aligned	Swing bent arms in opposition to legs
Running	Upper body straight and eyes focused in the direction traveled	Swing bent arms in opposition to legs	Knee drives upwards and forward to lift the foot off the ground	Knee and hip bend slightly to land softly
Single Leg Hop	Hips, knees and ankles aligned	Take off from one foot, land on same foot	Knees and hips bend to land softly in a controlled fashion	Swing arms to assist the movement
Single leg sideways hop and hold	Knees and hips bend to land softly in a controlled fashion	Hips, knees and ankles aligned	Foot flat on the floor	Stands up straight within three seconds after landing
2-foot to 1-foot hop and hold	Knees and hips bend to land softly in a controlled fashion	Toes pointing forward	Foot flat on the floor	Hips, knees and ankles aligned

90 degree hop and hold	Knees and hips bend to land softly in a controlled fashion	Hips, knees and ankles aligned	Whole body turns together	Toes pointing forward
Horizontal Jump	Swing arms to assist the movement	Knees and hips bend to land softly in a controlled fashion	Land on both feet at the same time	Hips, knees and ankles aligned
Vertical Jump	Swing arms to assist the movement	Knees and hips bend to land softly in a controlled fashion	Land on both feet at the same time	Hips, knees and ankles aligned

Appendix D: Knowledge and Understanding Questions

Each question has specific scoring criteria as follows:

Q1: How many minutes each day should you and other children do physical activities that make your heart beat faster and make you breathe faster, like walking fast or running? Count the time you should be active at school and also when you are at home or in your neighbourhood.

Correct answer = c : at least 60 minutes or 1 hour
1 = correct answer, 0 = incorrect answer

Q2: There are many different kinds of fitness. One type is called endurance fitness or aerobic fitness or cardiorespiratory fitness. Cardiorespiratory fitness means

Correct answer = b: how well the heart can pump blood and the lungs can provide oxygen
1 = correct answer, 0 = incorrect answer

Q3: Muscular strength or muscular endurance means…

Correct answer = a: how well the muscles can push, pull or stretch
1 = correct answer, 0 = incorrect answer

Q4: If you wanted to GET BETTER AT A SPORT SKILL, like kicking or catching a ball, what would be the best thing to do?

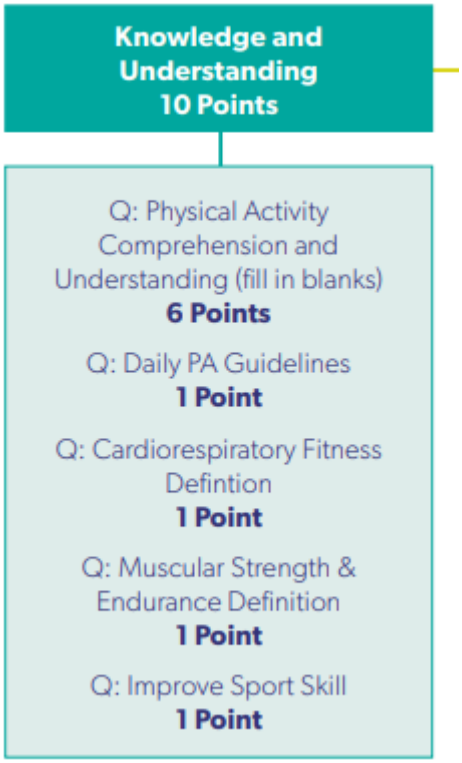
Correct answer = d: watch a video, take a lesson or have a coach teach you how to kick and catch
1 = correct answer, 0 = incorrect answer

Q5: Fill in the missing words

1 point for each correctly placed word (maximum of 6)

- 1st gap = 'fun'
- 2nd gap = 'good'
- 3rd gap = 'endurance'
- 4th gap = 'strength'
- 5th gap = 'stretches'
- 6th gap = 'pulse'

Appendix E: Knowledge and Understanding Scoring



Appendix F: Motivation and Confidence Questions

- Predilection score: The predilection score for physical activity is determined based on the response to the following 3 questions:

	Really true for me	Sort of true for me	Really true for me	Sort of true for me	
Some don't like playing active games	0.6	1.2	2.5	1.8	Other kids really like playing active games
Some kids don't have much fun playing sports	0.6	1.2	2.5	1.8	Other kids have a good time playing sports
Some kids don't like playing sports	0.6	1.2	2.5	1.8	Other kids really enjoy playing sports
Total Predilection score (sum of questions)					

Predilection score (range 1.8 to 7.5) = sum of scores for the above questions

- Adequacy score: The self-competence score for physical activity is determined by the responses to the following 3 questions:

	Really true for me	Sort of true for me	Really true for me	Sort of true for me	
Some kids are good at active games	2.5	1.8	0.6	1.2	Other kids find active games hard to play
Some kids do well in most sports	2.5	1.8	0.6	1.2	Other kids feel they aren't good at sports
Some kids learn to play active games easily	2.5	1.8	0.6	1.2	Other kids find it hard learning to play active games
Total Adequacy score (sum of questions)					

Adequacy score (range 1.8 to 7.5) = sum of scores for the above questions

Appendix G: Motivation and Confidence Scoring

Appendix H: PAC-Q

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	❍	❍	❍	❍	❍
Rowing/canoeing	❍	❍	❍	❍	❍
In-line skating	❍	❍	❍	❍	❍
Tag	❍	❍	❍	❍	❍
Walking for exercise	❍	❍	❍	❍	❍
Bicycling	❍	❍	❍	❍	❍
Jogging or running	❍	❍	❍	❍	❍
Aerobics	❍	❍	❍	❍	❍
Swimming	❍	❍	❍	❍	❍
Baseball, softball	❍	❍	❍	❍	❍
Dance	❍	❍	❍	❍	❍
Football	❍	❍	❍	❍	❍
Badminton	❍	❍	❍	❍	❍
Skateboarding	❍	❍	❍	❍	❍
Soccer	❍	❍	❍	❍	❍
Street hockey	❍	❍	❍	❍	❍
Volleyball	❍	❍	❍	❍	❍
Floor hockey	❍	❍	❍	❍	❍
Basketball	❍	❍	❍	❍	❍
Ice skating	❍	❍	❍	❍	❍
Cross-country skiing	❍	❍	❍	❍	❍
Ice hockey/ringette	❍	❍	❍	❍	❍
Other:					
_____	❍	❍	❍	❍	❍
_____	❍	❍	❍	❍	❍

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

I don't do PE ❍
Hardly ever ❍
Sometimes ❍
Quite often ❍
Always ❍

3. In the last 7 days, what did you do most of the time *at recess*? (Check one only.)

Sat down (talking, reading, doing schoolwork) ❍
Stood around or walked around ❍
Ran or played a little bit ❍
Ran around and played quite a bit ❍
Ran and played hard most of the time ❍

4. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

Sat down (talking, reading, doing schoolwork) ❍
Stood around or walked around ❍
Ran or played a little bit ❍
Ran around and played quite a bit ❍
Ran and played hard most of the time ❍

5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

None ❍
1 time last week ❍
2 or 3 times last week ❍
4 times last week ❍
5 times last week ❍

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

None ❍
1 time last week ❍
2 or 3 times last week ❍
4 or 5 last week ❍
6 or 7 times last week ❍

7. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

None ..... ❍
1 time ..... ❍
2 — 3 times ..... ❍
4 — 5 times ..... ❍
6 or more times ..... ❍

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involve little physical effort ..... ❍

B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) ..... ❍

C. I often (3 — 4 times last week) did physical things in my free time ..... ❍

D. I quite often (5 — 6 times last week) did physical things in my free time ..... ❍

E. I very often (7 or more times last week) did physical things in my free time ..... ❍

9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	❍	❍	❍	❍	❍
Tuesday	❍	❍	❍	❍	❍
Wednesday	❍	❍	❍	❍	❍
Thursday	❍	❍	❍	❍	❍
Friday	❍	❍	❍	❍	❍
Saturday	❍	❍	❍	❍	❍
Sunday	❍	❍	❍	❍	❍

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes ..... ❍
No ..... ❍

If Yes, what prevented you? _____