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The Impact of an Intentionally Designed Physical Literacy Recreation Program on the Fundamental Movement Skills of Kindergarten Children in Canada

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Larry Katz is an award-winning researcher, developer, and producer of interactive multimedia learning applications. Dr. Katz is a Professor Emeritus, at the University of Calgary. An Educational Psychologist, he is interested in how people learn and how they can improve their performance using innovation and technology. His patented and trademarked Move Improve® mobile platform for peer-to-peer, self-directed, consensus learning, and instructor evaluation, changes the way people learn.

Abstract

Purpose: A growing body of literature has suggested that providing children and youth with meaningful and intentional physical activity programming may result in better physical literacy development, including increases in physical competency, motivation, and confidence. The objective was to determine if an eight-month intentionally designed physical literacy recreation program would promote better fundamental movement skill development when compared to standard recreation programs.

Method: A total of 59-children, 4- to 5-years of age, were enrolled in either an intentionally designed physical literacy program (n=35), or enrolled into parent-selected programs (n=24). Children were assessed at the beginning and end of the program using the TGMD3 & BOT-2 assessment batteries.

Results: Results indicated a significant increase in fundamental movement skills between pre- and post-measures and a significant difference between sexs; however, program type was not a significant factor.

Conclusion: Findings suggest that extra-curricular recreation programming is beneficial to the fundamental movement skill development of kindergarten-aged children.

Keywords: recreation; children; fundamental movement skills; physical competency

Résumé

Objectif: De plus en plus d'études indiquent que le fait d'offrir aux enfants et aux jeunes des programmes d'activité physique pertinents et fondés sur la participation peut entraîner un meilleur développement de la littératie physique, y compris une augmentation des compétences physiques, de la motivation et de la confiance en soi. L'objectif est de déterminer si un programme récréatif de littératie physique de huit mois, conçu de manière significative, favoriserait un meilleur développement des habiletés motrices fondamentales par rapport à des programmes récréatifs standards.

Méthode: Un total de 59 enfants, âgés de 4 à 5 ans, ont été inscrits soit à un programme de littératie physique conçu de manière significative (n=35), soit à des programmes choisis par les parents (n=24). Les enfants ont été évalués au début et à la fin du programme à l'aide des batteries d'évaluation TGMD3 et BOT-2.

Résultats: Les résultats ont indiqué une importante augmentation des capacités motrices fondamentales entre les mesures, avant et après. Les résultats ont aussi indiqué une différence significative entre les sexes ; cependant, le type de programme ne constituait pas un facteur pertinent.

Conclusion: Les résultats suggèrent que les programmes de loisirs extrascolaires sont bénéfiques pour le développement des habiletés motrices fondamentales des enfants en âge d'aller à la maternelle.

Mots-clés: recreation; enfants; habiletés motrices fondamentales; compétence physique

Introduction & Literature Review

Recent studies have demonstrated an increasing rate of childhood sedentary behaviour and physical inactivity subsequently resulting in increases of childhood obesity and non-communicable diseases (Gray et al., 2015; Kuzik et al., 2015; Tremblay et al., 2015, 2016; Truelove et al., 2018). It has been suggested that the rapid increase in sedentary behaviour and physical inactivity may be directly impacting the holistic development of children and youth, including their physical literacy (PL) (Longmuir et al., 2015; Roetert & Jefferies, 2014). This has led to an evolving scientific area of inquiry, focused on examining how PL is learned and experienced across childhood, and the potential for PL to become a determinant of health and disease. (Cairney et al., 2019).

Physical literacy has been defined, from a Canadian context, as "the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life" (Tremblay et al., 2018, p. 16). The definition of PL focuses on four specific domains: (1) the affective domain, comprised of motivation and confidence; (2) the physical domain, comprised of physical competency and movement mastery; and (3) the cognitive domain, comprised of the knowledge and understanding of physical activity (PA) and relating it to lifelong health and wellness and (4) the social domain which includes an individual's sense of belonging (Longmuir et al., 2015; Tremblay et al., 2018; Whitehead, 2010). This definition is underpinned by the philosophical construct of embodiment and existentialism. Embodiment refers to the experiences one has and the subsequent meaning that one attributes to engaging in an activity or environment (Whitehead, 2010). Existentialism relates to the identity that one (re)constructs through the embodied experiences (Whitehead, 2010). This suggests that such experiences may contribute to the (dis)engagement with PA, health, and wellness of children as they age.

Sport and recreation provide many children with a variety of movement experiences. Such activities contribute to the development and mastery of fundamental movement skills (FMS). FMS provides the foundation for more specialised movement patterns and skills for participation in activities across a variety of environments (Hardy et al., 2012). FMS are separated into three distinct movement patterns: locomotion, object-control or object-manipulation, and stability (Payne & Isaacs, 2012; Ulrich, 2000; Webster & Ulrich, 2017). The development of these skills represent important milestones in the growth and development of young children and are considered to be the building blocks of continued participation. Fundamental movement skills focus on the acquisition and application of these skills to later engage in physical activity. It has been suggested that early childhood education settings (e.g., preschool, junior kindergarten, kindergarten), as well as early levels of formal education are arguably the most critical time for the introduction to, development, and mastery of, FMS (Hardy et al., 2012; Logan et al., 2013). Moreover, physical competency and the development of FMS more broadly, are often positively correlated to sustained PA engagement in children (Logan et al., 2013).

The Canadian Society for Exercise Physiology (CSEP) has created the first ever Canadian movement guidelines (Canadian Society for Exercise Physiology, 2021). The guidelines are designed to inform Canadians of what a healthy day looks like. The guidelines recommend appropriate time that individuals should engage in physical activity, as well as suggestions for sedentary and sleep behaviours (Canadian Society for Exercise Physiology, 2021). The recommendations are broken into age brackets for appropriateness; 0-4 years, 5-17 years, 18-64 years and 65+ years (Canadian Society for Exercise Physiology, 2021). The guidelines range from; Move, Sleep, Sit in the early years to Sweat, Step, Sleep and Sit in the later age brackets (Canadian

Society for Exercise Physiology, 2021). Current national PA recommendations suggest that children should be participating in at least 60-minutes of energetic play and/or moderate- to vigorous-intensity forms of PA each day (Canadian Society for Exercise Physiology, 2021).

As children spend approximately six-hours a day within an educational setting, physical education (PE) and daily physical activity (DPA) are two strategies to help meet this recommendation and promote the importance of PA (Giblin et al., 2014). Both PE and DPA provide children opportunities to engage in formal and informal learning, development, and mastery of FMS in both structured and unstructured forms. PE classes and DPA experiences can offer children and youth PA experiences across various physical environments, such as land, snow/ice, air, or water-based activities, connecting to the physical competency environments highlighted by Higgs (2010). Land-based activities would be inclusive of games such as tag, volleyball and soccer. Skating, and skiing would be examples of snow/ice activities while gymnastics and diving would be reflective of activities that happen in the air. Water experiences are demonstrated by activities such as swimming, underwater hockey and paddle boarding.

Well-structured PE classes have also been found to provide children with positive experiences through a sense of achievement, thus benefiting their physical competency development as well as their confidence and motivation, key aspects of the affective domain of PL (Roetert & MacDonald, 2015). As cautioned by Lounsbery and McKenzie (2015), intentionality in the way in which physical education curriculums are designed and delivered are essential as to avoid conflating physical education with physical literacy, recognizing that physical literacy development is an on-going process. These concerns, however, can be mitigated through teacher development, providing education on the development of well-rounded programs that not only develop children's physical competency, but also their cognitive and affective domains (Edwards et al., 2019; Essiet et al., 2020).

It is often presumed that children and youth meet the recommended 60-minutes of PA per day through participating in PE, DPA opportunities, and school recess. However, Beets and colleagues (2009) found that only 9 to 11% of children meet the PA guidelines within an education setting in the United States, while the ParticipACTION Child Report Card (2024) indicated that only 35% of children aged 5- to 11-years receive at least 150 minutes of PA during school time. In the early years (0-4 years) it has been found that globally, 11% of preschool-aged children are meeting the 24-hour movement guidelines of Move, Sleep, Sit as identified in a systematic review (Tremblay et. al., 2017). This may be further amplified in locations that have extreme temperatures and/or harsher weather environments, such as northern countries (Beighle et al., 2012; Ickes et al., 2016). In nations, such as Canada, where typical winter weather may result in extreme cold or blizzard like conditions, children and youth may not be provided opportunities to engage in DPA due to lack of proper clothing or equipment, lack of PA spaces, or parental/guardian safety concerns. Moreover, additional barriers within education settings, such as lack of resources, money, equipment, and space, may further accentuate the limited experiences children and youth may have within PE settings (Morgan & Hansen, 2008).

While PE and DPA may be limited within school hours, comprehensive school programming, before-school programming, and after-school programming may offer spaces to augment PA experiences in children and youth. Castelli and colleagues (2014) found that comprehensive school PA programs, including before and after-school programs, are effective in bolstering self-efficacy, healthy lifestyle management, and physical competency development in students. More recent studies have also demonstrated similar findings, including increased FMS development and increased perceptions of PL (Warner et al., 2021), and greater physical, cognitive, and emotional health (Caldwell et al., 2022). A systematic review conducted by

(Morgan et al., 2013) demonstrated that most studies focused on FMS interventions are often situated within education settings, with only one study being conducted within a recreation setting. This identifies a potential gap within the PL literature, with minimal studies investigating the role of recreation programming on the PL and FMS development of children.

As children are not meeting the PA guidelines and recommendations within an education setting (Beets et al., 2009; ParticipACTION, 2022), programming outside of school hours may facilitate great PL acquisition (Caldwell et al., 2022; Castelli et al., 2014; Warner et al., 2021). An opportunity exists within the recreation centre setting to offer after-school programming to encourage PA participation and increase activity levels (Van Wyk, 2016).

This research study is part of a larger, longitudinal study. The initial project began because of the 2005 Active Healthy Kids Canada Report Card that gave Canadian children an overall grade of 'D' (Active Healthy Kids Canada, 2005). A recreation centre in North central Calgary, Alberta, Canada wanted to explore opportunities, within their facility, to help improve this outcome. As a result, a pilot project emerged that explored a new and innovative approach to recreation programming that was grounded in physical literacy. The program included several elements such as aligning the program to the Alberta Education curriculum, Sport for Life philosophy of participation of physical activity in diverse environments, backward design in lesson planning, inclusion of play and one consistent program instructor (Van Wyk, McCallum & Katz, 2022). The combination of the program design elements as well as intentional activities to foster autonomy and belonging contribute to the development of the holistic construct of physical literacy. The objective of this study was to assess the impact of an eight-month PL program on the proficiency of fundamental movement skills of kindergarten-aged children when compared to participants registered in standard recreation programming. A secondary analysis was also completed to discern if a difference existed in fundamental movement skill proficiency, between the sexes. It was hypothesized that the specialized recreation program would yield better FMS development when compared to the standard recreation program.

Methods

Participants and Settings

The current study was one phase of a seven-year, quasi-experimental, longitudinal study, aimed at assessing the PL development of a cohort of children that would graduate through a series of specialised programming or standard recreation programming (Van Wyk, 2016). This study was approved by the institution's Research Ethics Review Board. The current study focused on physical competency development, as represented by FMS development, in the first year of the study. A total of 61-participants, ages 4 and 5 years of age, were recruited by way of convenient and snowball sampling. Two participants withdrew from the study, resulting in 59 participants completing the programs. Recruitment posters were placed at various locations in a recreation centre in the northern area of Calgary, Alberta, Canada and an email was distributed to the member base. To participate in the study, children had to be between 4- and 5-years of age, able-bodied, commit to 80% of the PA experiences, and could attend both evaluation testing periods. If families were able to meet and commit to the requirements of the research study, they were invited to participate. Families were asked to pay a deposit of $100 with the opportunity that this money would be returned upon completion of research study requirements. There was no cost associated with participating in the physical activity programs.

Participants were divided into one of two groups based on their eligibility and availability to participate in the research study. If children were able to participate on the days and times of

the specialized program, unbeknownst to the parents, they names were put into a randomizer. The first 40 participants were invited to the specialized program and 20 to the traditional recreation program. The final number of participants varied upon further details of the program being revealed. Once selected, those parents and guardians who were interested were contacted by the research team and invited to attend an information session. Consent and assent forms were distributed and completed at the information event.

Eligible participants were divided into two groups. The first group consisted of participants who were available to participate in an intentionally designed PL program, called 4in1. The program was called 4in1 because participants experienced physical activity opportunities in four different environments in one program. The second group included participants that participated in self-selected recreation programs offered by the recreation facility. Both groups of participants participated in PA experiences twice a week at the recreation facility, for a total of two hours per week for eight months. Participants in the 4in1 PL program were involved in a newly designed program that consisted of:

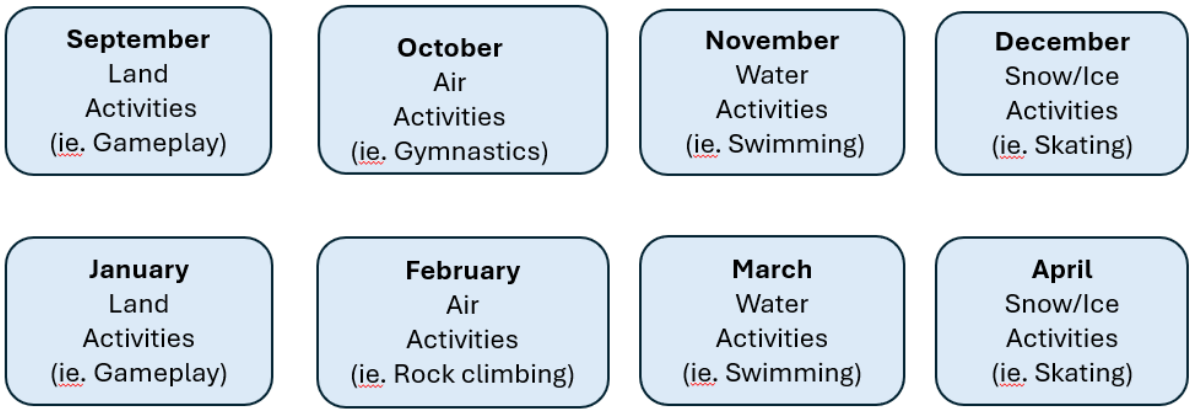
1. Diverse PA experiences on the land, air, water and snow/ice environments. This aligns to the Sport for Life philosophy;
2. One consistent program leader throughout the duration of the program;
3. The inclusion of high impact lesson plans (SPARK) which aligned with the Alberta Education Program of Studies for children in grades one and two;
4. Inclusion of unstructured play opportunities at the beginning and end of each class.

Recreation Programs

The specialized program, referred to as the 4in1 PL program, was positioned as the intervention program of this current study. The program was a specialised recreation program, created by the second author, and included programming across a variety of activities (e.g., Dance Play, swimming, gymnasium-based activities) and across the four PL environments (i.e., ground, water, air, snow/ice). The program was designed to have program participants experience a new PA environment at the recreation facility, twice a week, for one hour, each month, then the program participants rotated to a new environment. For example, participants would engage in land-based activities (i.e., gameplay) two times per week for the month of September and then do air activities (i.e., gymnastics) for the month of October. This is demonstrated in Figure 1 below.

Figure 1

Map of Physical Activity Experiences of 4in1 Program



All environments were rotated through over eight months, allowing children to have a month-long experience in each environment, twice during the intervention period. The intention of the structured program was to parallel and complement the Alberta Education elementary school PE curriculum outcomes, thus potentially augmenting physical competency development. The criteria based outcomes were incorporated into the physical activity experiences when applicable. The rationale by the program designer was to further provide participants with skill acquisition that had previously been identified as important for children to acquire within the education curriculum. Lesson plans were guided by SPARK PE curriculum design (Herrick et al. 2012; Sallis et al. 1999). Some of the SPARK program principles used included unstructured play at the beginning and end of each lesson and program leadership by a singular leader, with support from specialised program instructors in different PA environments (e.g., a certified skating instructor for ice-based activities). A total of 37-children were enrolled into the 4in1 PL program, 16 in a morning session and 21 in an afternoon session.

The standard recreation program group was positioned as the control group for the current study. Parents/guardians were invited to enrol their child in recreation activities of their choice, twice a week. Examples of such activities included programs such as swimming, skating, hapkido, and rock climbing. These activities could remain consistent over the eight-month period or could be changed every six-weeks at the family's discretion. Parents/guardians were able to select the activities from a broad list of sports and programs offered by the recreation facility, on days and times that worked best for them. A total of 22-children were enrolled into the standard recreation program group.

Assessment Tools

Anthropometric Measures

Height and weight measurements were collected from all participants. Height was measured to the nearest 0.1-centimeter using a Seca 213 Stadiometer (CSEP-PATH, 2013). Weight was measured to the nearest 0.1-kilogram using a Tanita BF-689 Children's Body Fat Monitor (CSEP-PATH, 2013). Both measurements were collected at the pre- and post-assessment days at the beginning of each participant's testing session. Parents/guardians were also asked to fill out a demographic questionnaire for their child which asked for information relating to their date of birth, ethnicity, location within the city, and estimated socio-economic status.

Test of Gross Motor Development (3rd Edition)

The most current gross motor assessment tool, the Test of Gross Motor Development 3rd Edition (TGMD3), was used to assess the locomotor and object-control proficiency of all participants. The TGMD3 is a validated and reliable motor assessment tool that assesses six locomotor skills and seven object-control skills (Webster & Ulrich, 2017). Following a process-oriented approach, each skill is broken down into a series of movement patterns, and the participant is scored on a dichotomous 0/1 scale based on their ability to correctly complete each criteria of the movement (Webster & Ulrich, 2017).

Bruininks-Oseretsky Test of Motor Proficiency, 2nd Edition

The valid and reliable Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition (BOT-2), Subset-5: Balance was used to assess the postural stability of each participant (Deitz et al., 2007). The subset assessed nine-items, including dual and single leg balance. This product-oriented approach included tasks that were scored based on time or distance. The BOT-2 was used in conjunction with the TMGD3, as the latter does not evaluate balance explicitly.

Procedures

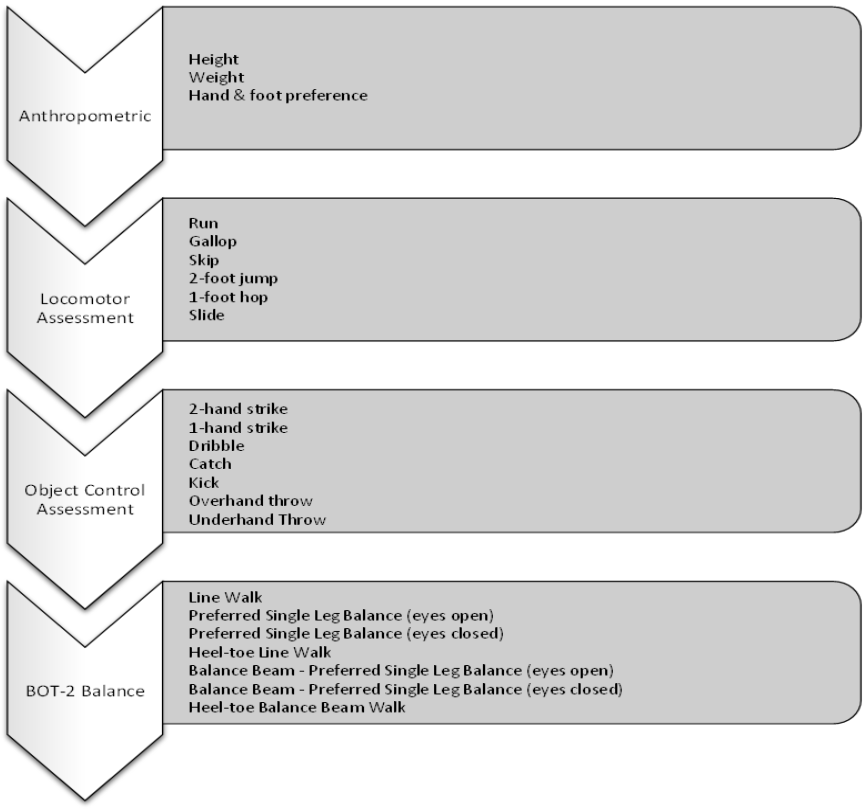
The data for the current study was collected at two independent measurement periods between 2015 (Fall) and 2016 (Spring). The primary author, along with a research assistant, conducted data collection. Anthropometric measures were collected at the beginning of each assessment, and the demographic questionnaire was completed by the parent/guardian of each child at the pre-assessment date.

At the beginning of each assessment, each participant was told what they would be doing in the assessment and informed that they could choose to participate or not to participate. The assessment protocol included anthropometric measures, TGMD3 locomotor assessment, TGMD3 object control assessment, and finished with the BOT-2 balance assessment (Figure 1). Each participant was provided an opportunity to practise the movement before engaging in two trials of each skill. The research member assessing all evaluations was trained in both the TGMD3 and BOT-2 test batteries and obtained a 90% inter-rater reliability with a trained evaluator prior to collecting data. Locomotor FMS were scored out of a total of 46-points and object-control FMS were scored out of a total of 54-points using the TGMD3. The BOT-2 balance subset was scored out of 37-points.

All assessments were scored as the participants were completing each task. Each assessment was also recorded using a digital recording camera (Panasonic HDC TM90) to allow for re-evaluation three- to five-days following the assessment. To ensure intra-rater reliability, approximately 10% of the videos were randomly selected and rescored and scores were compared to the in-person testing scores. A 98.4% intra-rater reliability score was maintained at both pre- and post-assessment.

Figure 2

Assessment Protocol



Statistical Analysis

Statistical analyses were completed using IBM SPSS Statistical Software (Version 24). Descriptive statistics were run to provide context to the data set. Paired-sample t-tests were used to identify significant changes in skill specific motor proficiency scores. A three-way (Group x Sex x Time) repeated measures analysis of variance (ANOVA) and a two-way ANOVA (Time x Sex) were used to assess motor proficiency development and mastery between assessment points. Bonferroni corrections were used for post-hoc analyses. All statistical analyses were conducted with the alpha level of 0.05.

Results

Fifty-nine of the 61-recruited kindergarten students (M_{age} = 5.2 ± 0.3 years) participated in the current study. Two-participants withdrew from the study between the pre- and post-assessment; therefore, their data were removed from analyses. Twenty-two (10 males, 12 females) participants were enrolled into the control group (standard recreation programming) and 37-participants (14 males, 23 females) were enrolled in the intervention group (4-in-1 PL program). Parents/guardians of 49 participants self-reported a medium income SES-status and 10-participants self-report a high-income SES-status. Table 1 displays anthropometric measures of each study group. The mean BMI of all participants was 15.18 kg/m^2 (± 1.51) at the pre-assessment evaluation, and 15.36 kg/m^2 (± 1.71) at the post assessment, with an average gain of 0.18 kg/m^2 (± 0.20).

Table 1

Anthropometric Characteristics of Participants

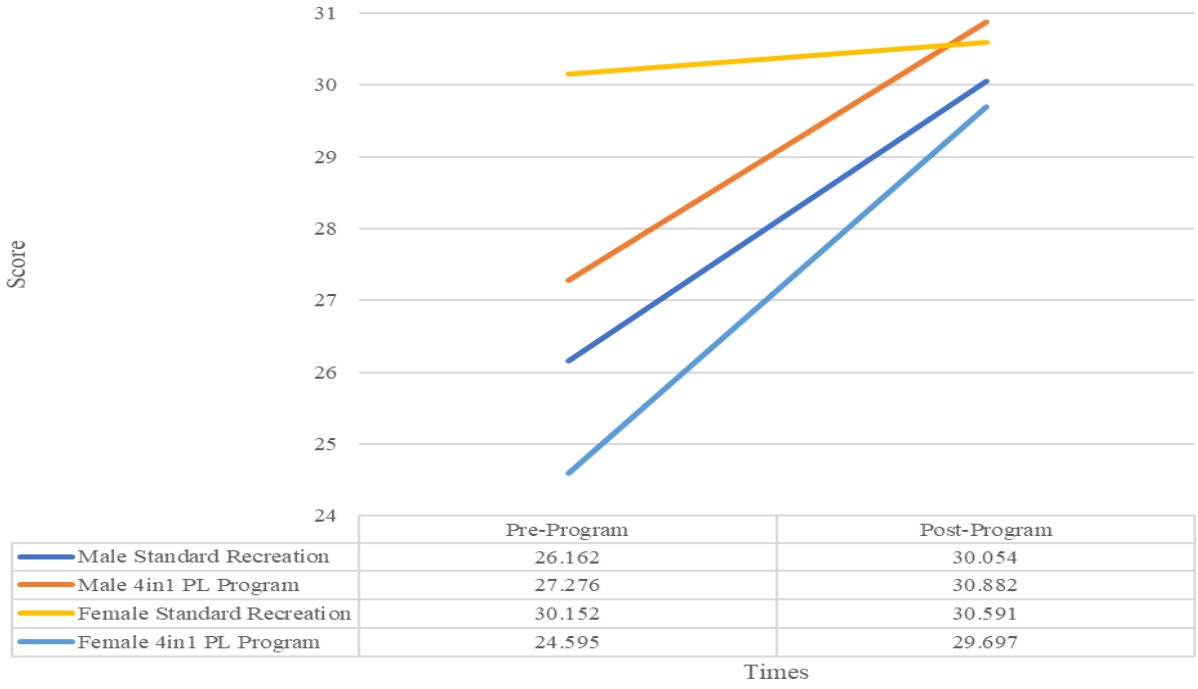
		Standard Recreation Program	4-in-1 Physical Literacy Program
Sex	Male	10	14
	Female	12	23
*Age (yr)		5.2 (0.3)	5.2 (0.3)
Estimated SES.	Low	0	0
	Medium	19	30
	High	3	7
PA Per Day (min)	0-60	6	12
	60-120	9	12
	120-180	7	6
	180-240	0	4
	240-300	0	2
	300+	0	1
*Pre-Assessment	Height (cm)	109.4 (4.1)	110.1 (4.2)
	Weight (kg)	18.1 (2.5)	18.5 (2.6)
	Body Mass Index (kg/m^2)	15.1 (1.7)	15.2 (1.4)
*Post-Assessment	Height (cm)	112.4 (4.3)	113.0 (4.4)
	Weight (kg)	19.2 (3.1)	19.8 (2.8)
	Body Mass Index (kg/m^2)	15.2 (2.0)	15.5 (1.5)

**Values expressed as Mean (Standard Deviation)*

A 3-way repeated measure ANOVA (group x sex x time) observed a significant difference in motor proficiency development and mastery in the males in the control group ($F(2,51) = 3.708$, $p = 0.017$), and both the males ($F(2,51) = 2.852$, $p = 0.046$) and females ($F(2,51) = 8.87$, $p < 0.001$) in the intervention groups. Pairwise comparisons demonstrated that females who participated in the 4in1 PL program experienced a significant increase in their TGMD3 locomotor skill development between pre- and post-difference ($Mean_{diff} = 5.1 \pm 1.4$ $p = 0.001$) (Figure 2). Pairwise comparisons demonstrated significant improvements in the TGMD3 object control skills for the males in the standard recreation program ($Mean_{diff} = 5.5 \pm 2.2$, $p = 0.014$), the males in the 4in1 PL program ($Mean_{diff} = 4.1 \pm 1.9$, $p = 0.033$), and the females in the 4in1 PL program ($Mean_{diff} = 4.0 \pm 1.4$, $p = 0.008$) (Figure 3). Finally, pairwise comparisons demonstrated that significant improvements in BOT2 balance for both the females in the standard recreation program group ($Mean_{diff} = 2.5 \pm 1.1$, $p = 0.030$) and females in the 4in1 PL program ($Mean_{diff} = 2.5 \pm 0.8$, $p = 0.003$) (Figure 4).

Figure 3

Pairwise Comparison of Locomotor Proficiency Development and Mastery based on Group x Sex x Time



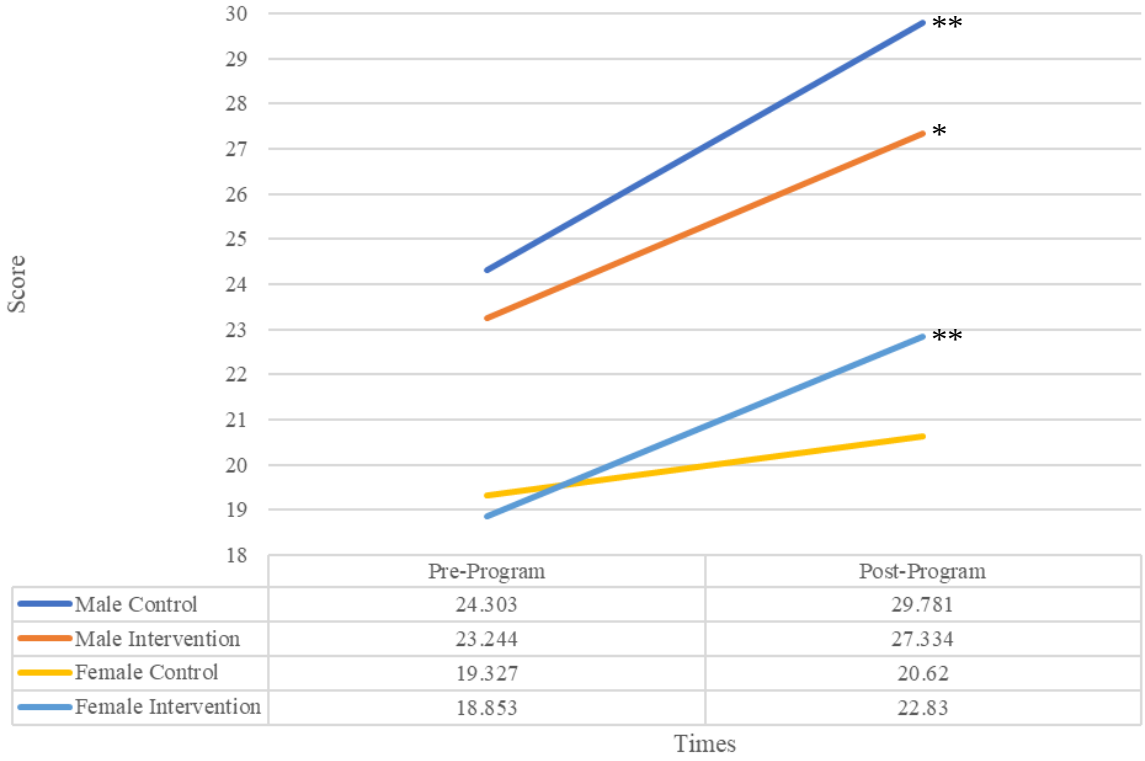
	Pre-Program	Post-Program
Male Standard Recreation	26.162	30.054
Male 4in1 PL Program	27.276	30.882
Female Standard Recreation	30.152	30.591
Female 4in1 PL Program	24.595	29.697

**Significant at p<0.05; **Significant at p<0.01; ***Significant at p<0.001*

A two-way ANOVA (time x sex) revealed significant sex differences at both the pre-assessment ($F(1,51) = 0.732$, $p = 0.001$) and post-assessment ($F(1,51) = 0.684$, $p < 0.001$), wherein males typically displayed better mastery than their female counterparts. Pairwise comparisons demonstrated that males were significantly better than females in the TGMD3 object-control tasks at both the pre-assessment ($Mean_{diff} = 4.7 \pm 1.8$, $p = 0.014$) and post-assessment ($Mean_{diff} = 6.8 \pm 1.9$, $p = 0.001$). The pairwise comparison also found that females were significantly better than males in the BOT2 balance tasks at both the pre-assessment ($Mean_{diff} = 2.7 \pm 1.2$, $p = 0.032$) and post-assessment ($Mean_{diff} = 3.3 \pm 1.3$, $p = 0.017$).

Figure 4

Pairwise Comparison of Object Control Proficiency Development and Mastery based on Group x Sex x Time

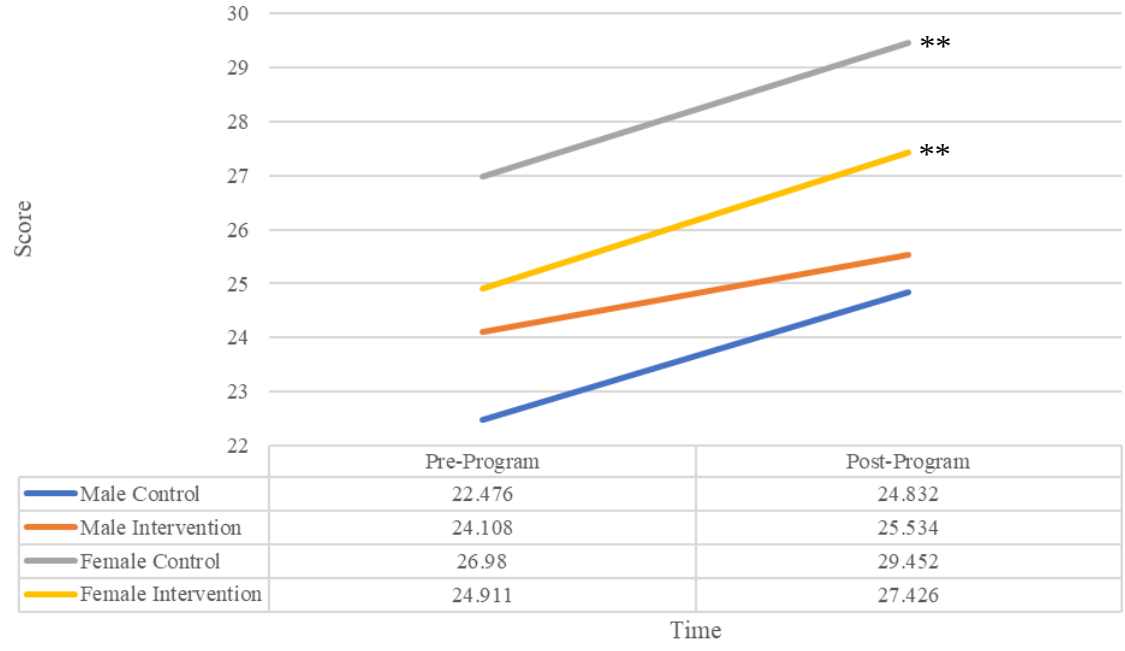


	Pre-Program	Post-Program
Male Control	24.303	29.781
Male Intervention	23.244	27.334
Female Control	19.327	20.62
Female Intervention	18.853	22.83

**Significant at p<0.05; **Significant at p<0.01; ***Significant at p<0.001*

Figure 5

Pairwise Comparison of Balance Proficiency Development and Mastery based on Group x Sex x Time



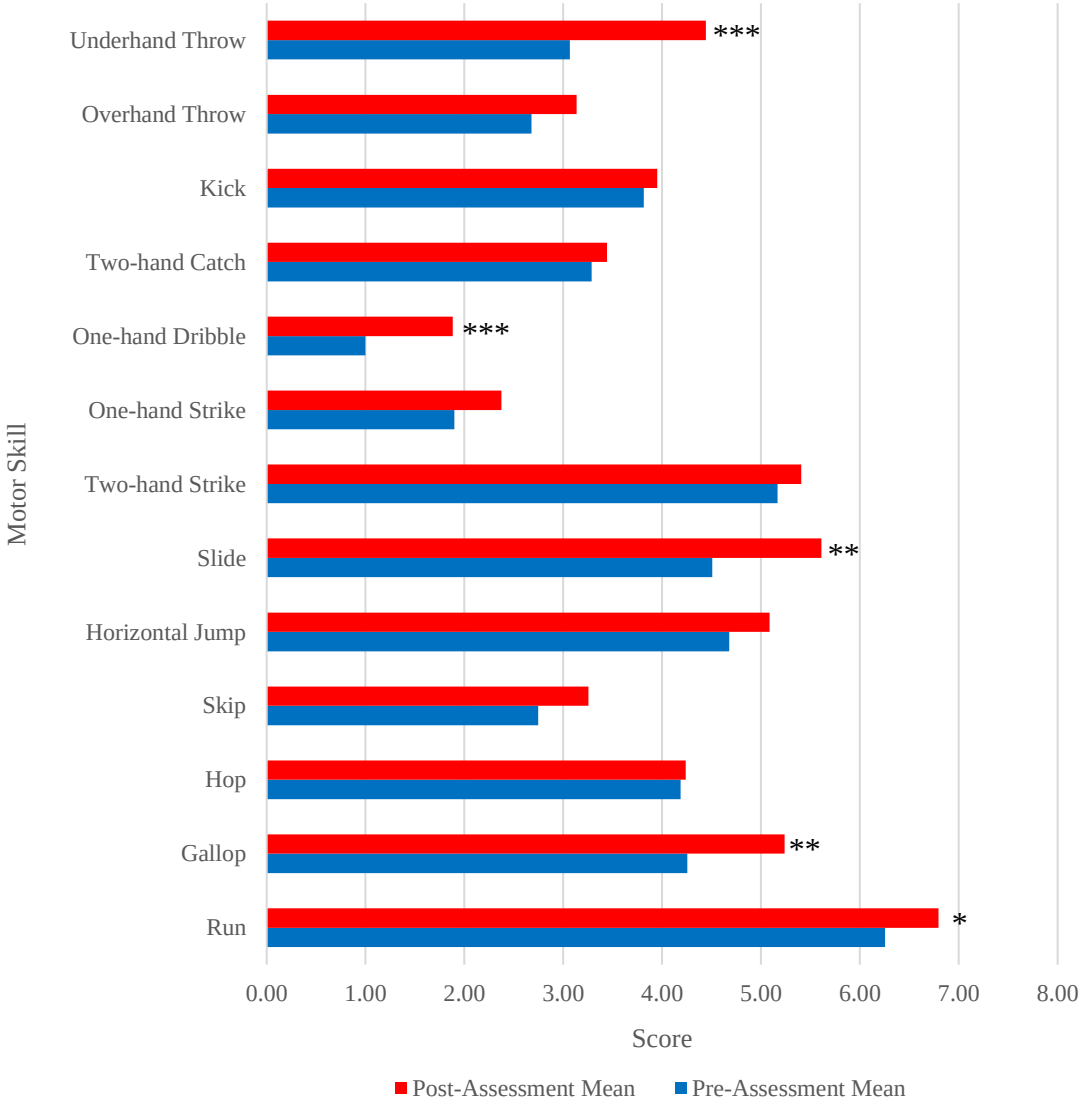
	Pre-Program	Post-Program
Male Control	22.476	24.832
Male Intervention	24.108	25.534
Female Control	26.98	29.452
Female Intervention	24.911	27.426

**Significant at p<0.05; **Significant at p<0.01; ***Significant at p<0.001*

Paired sample t-tests were conducted on each of the individual motor proficiency assessments across all participants (Figure 5). Specific to the six locomotor tasks, significant improvements were observed within the running task (t = 2.2, p = 0.03), the gallop task (t = 2.7, p = 0.009), and the slide task (t = 3.1, p = 0.003). Specific to the seven locomotor tasks, significant improvements were observed within the one-hand dribble task (t = 4.6, p < 0.001) and the underhand throw task (t = 4.7, p < 0.001).

Figure 6

Fundamental Motor Skill Scores at Pre- and Post-Evaluation



**Significant at p<0.05; **Significant at p<0.01; ***Significant at p<0.001*

Discussion

A growing body of evidence that suggests that an individual's PL may have a strong correlation on one's health and wellness (Barnett et al., 2016; Booth et al., 1999; Cairney et al., 2019; Lubans et al., 2010; A. D. Okely et al., 2004; Stone et al., 1998). Highlighted by Castelli and colleagues (2014), programs, such as before and/or after school comprehensive physical activity programs, have been found to provide increased physical activity engagement, thus improving one's physical literacy. As such, the development and delivery of a well-rounded PA program for children may mitigate negative health consequences related to physical inactivity and sedentary behaviour (Gray et al., 2015; Hills et al., 2007; Tremblay et al., 2016).

This study sought to understand the development of children's fundamental movement skill competency through their participation in an 8-month specialized recreation program (4in1) compared to standard recreation programming. The 4in1 PL program was designed under the premise that by allowing children to: (1) engage in a variety of activities using different teaching strategies; (2) engage in free and unstructured play at the beginning and the end of a program; and (3) that changed movement environments; children would develop better FMS and thus physical competency (Van Wyk, 2016). Following the completion of an eight-month intervention, while there was no significant difference in motor development and mastery found between the 4in1 PL program and standard recreation programs, there were significant improvements in locomotor and object control skills for both the male and female participants. This finding aligns with other studies assessing FMS development within children. For example, findings in this study align with the findings of Warner and colleagues (2021) who found that a Sport for Development program promoted significant improvements in locomotor and object control skills, as well as overall balance. It could therefore be suggested that the provision of any form of PA, including free play, PE interventions, recreation interventions, or sport programs, have been found to improve FMS across childhood (Barnett et al., 2010; Basman, 2019; Bolger et al., 2018; Hardy et al., 2010; Mostafavi et al., 2013; van Beurden et al., 2002).

Findings from this study also suggest that recreation, and intentional recreation programming, has a unique opportunity to continue the development and application of FMS in children. Designing recreation programs with purpose and intention alongside a trained and passionate instructor can provide a rich opportunity for the development of FMS alongside confidence and competence. Moreover, considerations to the pedagogical foundations of the program design and delivery, as well as consistency in program instructors and leader can also augment the success of FMS development in children (Roscoe et al., 2024). Through intentional program design, recreation can be a conduit to increased proficiency. In addition, such programming may lead to continued participation in physical activity.

Though no significant difference was observed between the 4in1 PL program and the standard recreation program, significant improvements were found across a number of locomotor and object control tasks, and between sexes. The findings related to both improvements in locomotor and object control skills align with the findings of the meta-analyses conducted by Morgan and colleagues (2013) and Van Capelle and colleagues (2017). Specifically, significant improvements were found in the underhand throw and one-hand dribble tasks within the object-control domain, and in the slide, gallop, and run tasks within the locomotor domain. These findings are consistent with the effect of program length (Krombholz, 2012; Matvienko & Ahrabi-Fard, 2010) and with programs working on specific motor pattern development (Matvienko & Ahrabi-Fard, 2010). The findings suggest that access to diverse recreation programming, that is intentional in its teaching of FMS development and opportunities that span a variety of recreation

settings/environments may result in greater developmental output. The diverse environments may offer children opportunities to engage in the constructs of the physical competency pillar, as theorized by Whitehead (2010), and allow for the practice of movements in non-conventional settings, and allow for the reading of the environment to practice different skills.

Previous literature has suggested that sex disparities begin to occur in FMS in childhood, wherein males display higher forms of mastery when compared to females especially in FMS related to object control skills (Antonakopoulou et al., 2009; Bolger et al., 2018; Booth et al., 1999). Similar to these studies, the current study also found that males typically displayed better FMS competencies, specifically tasks that required object manipulation (Booth et al., 1999; Eather et al., 2018; O'Brien et al., 2015; Okely et al., 2001). However, a somewhat unique findings of this study also found that females in both the intervention and control group had significant improvements in the object-control skills between the start and end point of the program. The findings of this study could be explained by the unique aspects of ball-control work the 4in1 PL program as well as the variety of multi-sport programs that are offered within the standard recreation programming at the recreation facility that this study took place in (Guest et al., 2017). By providing children, specifically girls who are often found to be limited in their object control skills, diverse physical activity opportunities that include eye-hand coordination movement patterns, significant improvements in object control skills could be present, which could provide greater opportunities for diverse sport and activity engagement at later stages of life.

Limitations

While this study did ensure a high level of reliability and validity through the selection of established FMS assessments and by conducting intra-rater reliability checks, this study was not without limitations. Given the age of the participants, they may have been experiencing normal unpredictable growth which may increase the difficulty in isolating (with certainty) the effects of the intervention. As such, significant improvements in their motor skills may not have been a direct function of the programs themselves. Future studies may want to consider a more longitudinal approach to track changes from early childhood setting through late childhood.

Another limitation to assessing FMS is the lack of a gold-standard assessment battery. By not having a gold-standard assessment battery, it falls upon the researcher to determine the most effective assessment battery that allows for a rigorous examination of the quality and/or quantity of the skill(s) being developed. For the current study, the process-oriented TGMD-3, and product-oriented BOT-2, were selected to assess locomotor, object-control, and balance skills, respectively. Both batteries have been validated and are considered reliable instruments for FMS assessments (Deitz et al., 2007; Webster & Ulrich, 2017). It is important, however, to highlight that while these assessments do have standardized norms, these norms may not be generalizable to this particular sample. Finally, it is important to consider that the Hawthorne effect may have influenced the performance of the participants (Kowalski et al. 2017). Participants may have experienced higher amounts of anxiety during the assessments, thus having varying effects on their skill performance. This may have resulted in an over- or under-representation of specific skill development. Due to the testing protocol, this is an inherent bias. In an attempt to limit this bias, the lead author ensured that the participants had time to orient themselves with the testing environment and the tasks being performed.

Another limitation to this study is related to the amount of physical activity a child receives throughout the week. More consistent engagement in physical activity, especially within the younger years of childhood, can augment the development of skills and abilities. As such, tracking the daily physical activity of a child over the duration of a week could help identify the effect of

the intervention itself, in relation to the augmentation of other physical activity opportunities. Future studies may want to include the provision of a pedometer or accelerometer to be able to assess the efficacy of an intervention designed to improve FMS.

The study also did not track other types of PA programs that control group participants may also have been enrolled in. As adult caregivers were instructed to enrol their child into a series of self-selected programs offered by the recreation centre, the type of programming and the number of times the child was enrolled would have benefitted in ascertaining if there were some programs that were engaged with more often, and the effect it may have had on the FMS development of the child. Future studies may want to collect this information and apply it within their analyses.

A final limitation is the inclusion criteria. Only able-bodied individuals were invited to participate in this study. Future opportunities should explore how this type of program may impact both able and individuals with limited mobility.

Conclusion

The current study highlights the findings of the first year of a multi-year study examining differences between recreation programming. Although this study did not establish a significant difference in motor proficiency interventions between groups, it did identify the importance of recreation programming in FMS development. Findings of this study demonstrate the importance of childhood physical activity engagement, broadly, with recreation being a feasible area to benefit from physical activity interventions. Moreover, findings from this study align with the current literature suggesting males demonstrate advance FMS development when compared to females at this age. Additional attention should be paid to the development of object-control skills, specifically in females, as inadequate development may potentially limit girls from participating in other sports or activities involving object-manipulation skills as they age. Future researchers may also want to work with the recreation sector in a greater capacity to provide quality FMS experiences for children and youth, with the hope of fostering a more active population.

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