

Contributions of After School Programs to the Development of Fundamental Movement Skills in Children

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ABSTRACT

International Journal of Exercise Science 7(3): 236-249, 2014. Fundamental movement skill (FMS) proficiency or the ability to perform basic skills (e.g., throwing, catching and jumping) has been linked to participation in lifelong physical activity. FMS proficiency amongst children has declined in the previous 15 years, with more children performing FMS at a low-mastery level. These declines may help explain the insufficient levels of participation in health promoting physical activity seen in today's youth. The after school time period (e.g., 3 to 6 p.m.), is increasingly considered an opportune time for physical activity interventions. To date, little research has examined the potential for after school programming to improve FMS proficiency. Participants (n=40, 6-10 years) of two existent physical activity based after school programs, a low-organized games and a sports-based program, were pre- and post-tested for FMS proficiency using the Test of Gross Motor Development-2 (TGMD-2) over an 11-week period. The sports-based program participants showed no improvement in FMS over the 11-week study ($p=0.91$, $\eta^2=0.00$) and the games-based program participants significantly improved their proficiency ($p=0.00$, $\eta^2=0.30$). No significant ($p=0.13$, $\eta^2 = 0.06$), differences were found in change in FMS scores between the low-organized games program participants and the sport-based program participants. These results suggest that after school programs with a low-organized games-based focus may support a moderate improvement in FMS proficiency in young children. Better training of after school program leaders on how to teach FMS may be necessary to assist children in acquiring sufficient proficiency in FMS.

KEY WORDS: Motor development, motor competence, children, youth

INTRODUCTION

The extensive health benefits individuals obtain from regular participation in physical activity are well-documented in the research literature (16, 25). Even with these known health benefits, physical activity participation levels in children and adults are low with only a small portion of the population in the USA and Canada

meeting the government recommended guidelines for weekly physical activity (6, 10, 11, 30, 32). Improving current participation in physical activity in children and youth must be considered a priority, particularly as participation in physical activity early in life may predict adult participation in physical activity (29); however, it is necessary to first understand the multitude of factors that contribute to

long-term participation. While several factors have been shown to affect physical activity participation (e.g., socioeconomic status, geographic location, age, sex) (35), fundamental movement skills (FMS) have recently been recognized as a potentially important influencing factor (4, 8, 15, 36). FMSs are considered to be the building blocks to sport-specific skills and include motor skills such as throwing, catching, kicking and running. These skills, in turn, are proposed to lay the foundation for successful lifelong physical activity participation (4, 8, 15, 26, 36). While much is left to be understood, the link between FMS competence and physical activity participation appears to emerge in middle childhood, and strengthens as children move into late childhood and adolescence (26); with some research noting similar, but weaker associations in early childhood (14). In early childhood, perceived motor competence, or one's judgement of FMS proficiency, is typically an inaccurate reflection of actual skill; and children will engage in physical activity regardless of potentially low motor ability proficiency (26). Alternatively, in older children and adults, perceived competence is reflective of actual motor ability, and may become a barrier for individuals to participate in physical activity, as they may not feel capable of successfully engaging in physical activity (26). For older children and adults, there appears to be a "proficiency barrier" or a basic level of motor competence required to feel confident or capable enough to participate in physical activities, including sports (26). FMS proficiency has also been linked to better health related measures, including lower weight status and higher cardiovascular fitness, providing further evidence for the importance of developing strong motor

skill proficiency in children (3, 4, 5, 15, 17). Importantly, recent studies have shown that today's youth have reduced levels of motor skill proficiency in comparison to samples measured 5-10 years earlier (20). These data suggest that low levels of motor skill competence may be contributing to the high levels of inactivity and consequent rise in the number of overweight and obese individuals apparent today (8, 15, 26).

Current high levels of population wide inactivity, coupled with the evidence supporting the relationship between FMS proficiency and engagement in lifelong physical activity, has highlighted the need to explore ways to assist children in developing FMS proficiency from an early age. Moreover, there appears to be a need for interventions that target FMS development in children and youth. Likewise, there is a need to determine how best to improve FMS (5, 18, 33, 34). Previous studies have primarily utilized activity breaks in the school day, or physical education (PE) classes to improve motor skill proficiency, with positive improvements noted in FMS performance amongst school aged children (5, 33, 34). Given the overprescribed school curriculum among other reasons, there has been a shift to focus on the after school time period for physical activity interventions (1), a time that may also be of use for an emphasis on FMS development. A few previous studies examined FMS development in the after school time period using intensive interventions and noted positive improvements in motor skill performance following 4 or 10 weeks of specific FMS training in elementary school-aged children (7, 18). These studies provide evidence that FMS improvement during the after school time period is feasible;

however, this has only been shown in targeted intervention settings with specifically trained instructors. No research to date has examined FMS improvements in existent after school care programs that do not have a direct focus or goal to improve FMS. Thus, there remains a gap in the literature in understanding the feasibility of FMS improvement during the after school time period, and how programming can be tailored accordingly. This study aimed to examine the effects of two existing after school physical activity programs, a sport-based program and a low-organized games-based program, on FMS development over an 11-week period.

METHODS

Participants

This research project employed a quasi-experimental design to examine the effects of program type, low-organized games versus sports, on FMS development over an 11-week period in children between the ages of 6-10 years. This research initiative was part of a larger project that also examined time spent in various intensities of physical activity during after school program time. The protocol was reviewed by Dalhousie University's Health Sciences Research Ethics Board.

The two after school programs were selected following an internet search of all currently offered after school programs in the Halifax Regional Municipality. Both programs were located in the Metro Halifax region, an urban region. The two programs were selected because of their stated philosophies and program goals and their representation of a low-organized games and a sports-based program model. As well, both programs had access to indoor

and outdoor play space, jungle gym equipment, and a wide variety of sporting and game equipment. Inclusion criteria also necessitated ongoing "in-house" training for program leaders on programming and participant management, and daily after school care offered to children inclusive of ages 6 to 10 years. Finally, to be included in this study, the programs could not be implementing specific FMS development interventions.

Administrators provided leaders in both programs a skeleton schedule of programming to undertake each week, with a one hour time period for structured activity. Program leaders were also given considerable freedom to alter programming to fit the interests and needs of the participants. As well, participants in both programs were divided into sub-groups during structured activity time to ease participant management resulting in participants not taking part in all activities offered. Although both programs had similar access to indoor and outdoor space and equipment, the low-organized games program primarily took place outside and the sport-based program was held primarily indoors. Activities undertaken at both programs were formally recorded for one-week for comparison (see Table 1). Only minor variations of these activities were observed in other weeks of the program. Some similarities existed between the two programs, including swimming activities, floor hockey and soccer activities. Researchers noted anecdotally that in each program there was the opportunity for a "kids' choice" activity once or twice each week, with participants choosing similar activities in each programs.

MOTOR SKILL DEVELOPMENT AFTER SCHOOL

Table 1. Activity options offered at low-organized games and sports-based programs during one week of programming.

	Low-organized games program activity options	Sports-based program activity options
Monday	Neighbourhood walk Basketball, and obstacle course Free play in the pool Ball hockey	Dodgeball Swim lessons and water polo
Tuesday	Movie Arts and crafts and indoor games Indoor low-organized games	Craft Floor hockey Swim lessons
Wednesday	Semi-structured outdoor free play Tag games Soccer baseball Frisbee activities	Indoor wall climbing Dodgeball Swim lessons
Thursday	Tag and races Field games Scavenger hunt Fire extinguisher demonstration	Badminton Block play
Friday	Out trip and games at nearby park/playground Free play Soccer Free play in the pool	Free play in the pool Soccer

Note: Program participants engaged in one of the listed activities or activity sets each day.

Prior to the start of the program year, an information letter outlining the research project was distributed by program administrators to parents of program participants via email. During the first week of each program, the principal investigator provided information sessions for participants during program time and distributed letters of invitation including informed consent forms to all 135 program participants. Additionally, she attended several activity sessions during the first weeks of both programs to answer parent and participant questions and collect informed consent and assent forms. Pre-testing of motor skill proficiency began after receiving a minimum of five informed consent and assent forms from each program. Rolling recruitment continued for 3 weeks and was closed to allow for a

minimum of 11 continuous weeks of program participation prior to the winter school break. Parents/guardians of 40 participants provided informed consent. The participants themselves also provided their assent to participate. Program administrators provided registration information of each participant, including the number of days each participant was registered in the program. Actual attendance was not taken due to the inability to obtain this data from program administrators.

Protocol

Birth date and sex were collected from participants to establish demographic data. Additionally, height to the nearest 0.1cm using a seca portable stadiometer (seca GmbH & Co., Hamburg, Germany) and

weight to the nearest 0.1 kg using a Health o Meter digital scale (Model: 349KLX, Jarden Co, Rye, NY) were measured. Parents/guardians of children who returned informed consent/assent were also asked to return an information sheet prior to the start of testing listing any planned structured physical activity programs their child would participate in on a weekly basis during the data collection period, including how many hours per week the child participated in each activity. This sheet was developed for this research project, to determine if physical activity in other programs may have influenced the results. For example, if 30% of children from the sport-based program played soccer, skill development may have been affected. Information sheets were screened, and any non-structured activities parents may have listed in error (i.e., walking to school, playing in backyard with siblings) were not included in data analysis.

Motor skill proficiency was tested using the Test of Gross Motor Development 2 (TGMD-2) (Pro-Ed, Austin, TX). The TGMD-2 is a validated and reliable measurement tool for measuring FMS proficiency using twelve skills categorized into two sub-tests: locomotor and object control. Test-retest reliability was established to be $r=0.88$ ($\alpha=0.85$) for the locomotor sub-test and $r=0.93$ ($\alpha=0.88$) for the object control subtest (31). The test utilizes process- and outcome-oriented measures. Process-oriented tests measure how a skill is performed (i.e., properly timed trunk rotation), whereas outcome-oriented tests measure the end results of a skill (i.e., was the ball caught) (26). Twelve skills, six object control and six locomotor skills are tested using the TGMD-2. Results from these individual skill tests form two

subtest scores, locomotor and object control, as well as an overall motor proficiency score, known as the Gross Motor Quotient (GMQ) (31). The TGMD-2 was selected for use in this study because it incorporates process-oriented measures of motor skill proficiency, which are more likely to be associated with physical activity participation (26). Additionally, score rankings for the TGMD-2 are derived from age- and sex-based normative data, which ensures that as children get older their overall GMQ is reflective of their physical growth, maturation, and development, as well as their skill (31).

Motor skill proficiency tests were videotaped and scored after testing according to guidelines set forth in the TGMD-2 manual (31). A selection of 10 tests (5 pre- and 5 post-tests) were reviewed by secondary analysts, one who examined the locomotor subsection of the tests, and one who examined the object control subsection. This breakdown was to accommodate time and training constraints. Each analyst received a training session from the principal investigator on how to score motor skills according to the TGMD-2 manual, and given time to read the TGMD-2 manual independently. Both analysts were Kinesiology students (one upper undergraduate level and one graduate student), with a basic background in movement analysis. This training was done utilizing a participant's test that was not scored in the secondary analysis to avoid directly influencing the analyst. Inter-rater reliability was found to be good ($r=0.80$) for the locomotor sub-test and excellent ($r=0.93$) for the object control sub-test as measured by Cronbach's alpha.

At pre- and post-test of FMS using the TGMD-2, height and weight were measured. Pre- and post-test measures were separated by a period of 11 weeks. In an effort to provide comfort while testing, children were tested in pairs and blinded to all results.

Statistical Analysis

All statistical analyses were undertaken using SPSS Version 20 (IBM, Armonk, NY). Mean and standard deviation were calculated for age, height and weight. Independent sample t-tests were used to assess differences between programs in pre-test, post-test, and calculated change scores of motor skill proficiency as measured by the GMQ, locomotor, and object control sub-scores. Paired t-tests were used to assess differences in pre-test and post-tests scores of motor skill proficiency within each program. Statistical significance was set at $p=0.05$. To estimate effect size, eta squared (η^2) was computed and reported. An effect size of 0.01 is considered small, 0.06 is moderate, and 0.14 is large (9). Change scores were calculated by subtracting post-test scores from pre-test scores. Percentile rankings were determined through scoring tables as printed in the TGMD-2 Examiner’s Manual (31). Independent t-tests were used to compare the hours spent in other structured physical activities as reported by the parents of participants in the two programs.

RESULTS

Demographic, anthropometric, and registration information for the 40 individuals who took part in pre- and post-testing can be found in Table 2. Although there were more girls who participated in

the low-organized games-based program, there were no significant differences ($p<0.05$) in age, height, weight, or body mass index in the participants of the two programs at baseline. The number of participants who were overweight or obese was not reported due to the small sample and consideration for maintaining participant confidentiality. Participants in the low-organized games-based program were registered five days per week, versus the sport-based program participants who were registered an average of 3.67 days per week.

Table 2. Pre- and post-test sex, age, height, weight, and registration of after-school program participants.

	Games	Sports
Sex		
Male	9	8
Female	16	7
Age (years) ($\bar{x} \pm SD$)		
Pre-test	7.64 \pm 1.06	8.05 \pm 1.08
Post-test	7.87 \pm 1.07	8.37 \pm 1.27
Height (cm) ($\bar{x} \pm SD$)		
Pre-test	126.22 \pm 10.33	129.57 \pm 8.09
Post-test	127.42 \pm 10.38	130.69 \pm 8.29
Weight (kg) ($\bar{x} \pm SD$)		
Pre-test	27.85 \pm 8.19	28.11 \pm 7.67
Post-test	28.24 \pm 8.57	28.25 \pm 6.62
Days registered in program, (\bar{x})	5	3.67

A significant difference and large effect size was found within the low-organized games program participants GMQ scores between pre-test (83.20 \pm 12.09) and post-test (88.84 \pm 8.90) ($p=0.00$, $\eta^2=0.30$). The sport-based program participants had no improvement in GMQ between pre-test (89.20 \pm 10.26) and post-test (89.60 \pm 12.05) ($p=0.91$, $\eta^2=0.00$). No significant differences were found between the low-

Table 3. Pre-test and post-test GMQ* and GMQ change scores for the low-organized games and sports-based after school programs, and between group differences represented by p-value and effect size.

	Games ($\bar{x} \pm SD$)	Sports ($\bar{x} \pm SD$)	p-value	Effect size (η^2)
GMQ				
Pre-Test	83.20±12.09	89.20±10.26	0.12	0.06
Post-Test	88.84±8.90	89.60±12.05	0.82	0.00
Change score	5.64±8.76	0.40±12.82	0.13	0.06
Locomotor Score				
Pre-Test	36.48±5.95	38.20±5.66	0.37	0.02
Post-Test	38.84±4.00	39.80±5.23	0.52	0.01
Change score	2.36±4.24	1.60±4.15	0.58	0.01
Object Control				
Pre-Test	30.24±8.32	35.00±7.56	0.08	0.08
Post-Test	32.72±6.66	36.27±10.75	0.20	0.04
Change Score	2.48±5.47	1.27±8.84	0.59	0.01

* GMQ = Gross Motor Quotient. Note: Effect size values: Small = 0.01, Moderate = 0.06, Large = 0.1 (8).

organized games or sports-based program participants when comparing pre-test, post-test or change scores in GMQ, locomotor or object control scores. A moderate effect was noted in comparison between pre-test GMQ scores ($\eta^2=0.06$) and pre-test object control scores ($\eta^2=0.08$), as well as GMQ change scores ($\eta^2=0.06$) between the participants in the two programs. Table 3 provides mean and standard deviations for all FMS scores. GMQ scores for the participants in the low-organized games program GMQ were between the 12th and 16th percentile at pre-test, and the 21st and 27th percentile at post-test. The sports program participants scores were at a percentile rank between the 21st and 27th percentile at pre- and post-test (25). The low-organized games program demonstrated a 6.8% increase in GMQ score over the 11 weeks, and the sport-based program participants demonstrated a 0.0% change. Motor skill data comparisons are presented in Table 3. Individual skill score changes are represented in Figure 1. No statistically significant differences, as measured by independent t-tests and effect size were found in any individual skill score between the two groups.

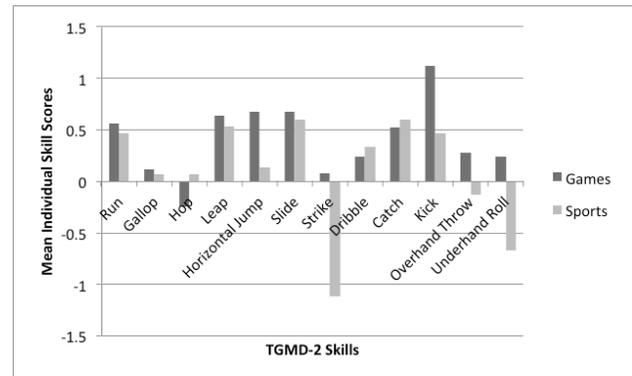


Figure 1. Mean change scores in 12 individual skills tested using the TGMD-2 for the low-organized games and sports-based programs, no statistical significant differences were found between the two groups for any individual skill.

Participants of the low-organized games and sports-based programs attended a range of other structured physical activity programs with no significant differences in the weekly hours of self-reported participation in other programs between the participants of either the sports-based (2.78 ± 2.94 hours) and low-organized games program (2.40 ± 1.56 hours), ($p=0.64$). Wide variance was noted in the types of structured physical activity programs self-reported with no trends found within or between groups. Activities reported for

both groups included dance, hockey, soccer, basketball, martial arts, swimming lessons, and ringette.

DISCUSSION

Participants in the low-organized games program showed significant improvement in FMS from pre- to post-test as measured by the GMQ; however, in comparison to the sports-based program participants over the 11-week study period, this improvement was not significant. More specifically, no significant differences were found in total GMQ, or any locomotor or object control subscores when comparing the results of the participants in the two after school programs. Overall the results of the current study provide moderate evidence that a low-organized games-based program promotes improvement in FMS proficiency in children over 11 weeks of participation. This result should be interpreted with caution; however, as the low-organized games program participants had lower pre-test GMQ scores than the sports-based program participants and therefore more room to improve. Direct comparison of the results from this study and other similar research projects is difficult due to differing tests of FMS, as well as the targeted intervention design of previous studies, opposed to the examination of the impact of existent programming (7, 18). Two previous studies reported FMS improvement in percentage, with one study showing a 7.2 to 25.7% increase in individual skill scores following a targeted physical education lesson intervention (3) and another showing an 11 to 13% improvement in FMS following a 10-week after school program intervention (7). The improvement noted in the low-organized games-based program participants was

smaller (6.7%) in this study than found in these targeted interventions, but comparable to the minimum increase of 7.2% seen by Barnett et al. (3). A systematic review of 19 interventions highlighted that those most successful at increasing FMS utilized physical education specialists or highly trained classroom teachers (for school-based interventions) as well as provided developmentally appropriate activities (19). In order for more substantial improvement to be seen in FMS proficiency, a more formal approach to teaching FMS should be utilized.

The low-organized games participants demonstrated a moderate improvement in FMS proficiency in this study, as evidenced by the significant difference between pre- and post-test GMQ scores ($p=0.00$, $\eta^2=0.30$) as well as the moderate effect ($\eta^2=0.06$) found between the group GMQ change scores (Table 3). Of note, the FMS scores of the low-organized games-based program participants at post-test increased to a level similar to that of the sports-based program participants. Specifically, on average, the participants in the low-organized games program improved their mean percentile ranking scores from the 12th to 16th percentile to the 21st to 27th percentile, an increase of between 9 and 11 percentile points. This increase eliminated the discrepancy in FMS, as measured by GMQ scores, found at pre-test between the participants of the two programs. While most past research has not focused on program type in developing FMS, one study noted that participants in low-organized games programs may experience higher levels of motivation and engagement in physical activity (24). Ultimately, the limitations of this study including the small sample size, in

conjunction with the difficulty of directly comparing the findings to previous research make it difficult to interpret the improvement in FMS of the low-organized games participants as meaningful.

Given the lack of improvement in FMS proficiency found in the sports-based program participants and the small, but significant improvement for the low-organized program participants, better training of after school program leaders on FMS acquisition is necessitated. This is in line with previous research, and suggestions made for physical education teachers (19). Beyond this, greater understanding of the types of skill practice needed to learn and improve FMS is needed. Incorporating motor learning principles into program design may be necessary in order to effect meaningful change on FMS proficiency. Three key elements of learning and improving skills are practice time, motivation and feedback of the participants, with each of these elements providing an area for potential improvement in programming and training of program leaders (23). These three elements are echoed in Physical and Health Education Canada's nine educational strategies to improve physical literacy, a concept that is inclusive of FMS proficiency (21). For example, the strategies of enjoyment, diversity and ability all influence motivation, through encouraging fun in activities, as well as discouraging comparison to others (21). Providing training such as the strategies outlined on Physical and Health Education Canada's website may be an important first step in improving FMS instruction in after school programs.

Specific to practice, participants showed improvements in skills that the children were given opportunities to practice, based on the weekly activity schedule such as kicking relating to soccer-based activities, but for other measured skills may not have had adequate opportunity for practice in order to improve significantly. In some cases there may have been a loss of skill. For participants in the low-organized games group, there was a mean increase in over 1.0 point on the kick skill score, which while non-significant, equates to participants mastering one of the skill components as measured by the TGMD-2 (31). A combination of program leaders coordinating soccer-related activities (i.e., soccer and soccer baseball), as well as the access to open field space and soccer balls during free-play time periods in the low-organized games program, could have contributed to the improvement noted in kicking. This further emphasizes the need for tailored instruction, focusing on specific FMS skills, as the soccer-based activities likely contributed to the improvement of kicking skill through multiple practice opportunities over time. Conversely, the participants in the sport-based program decreased in their mean skill score for the strike by more than 1.0 point. This decrease may be due to an inconsistent ability to perform the skill, individual child motivation, limitations of the test itself, or a lack of practice of these specific skills (2). Previous activity history was not measured; therefore, this skill loss cannot be definitively attributed to a lack of practice and/or be completely explained. This highlights the need for ongoing skill practice, which previous research indicated should be matched to developmental ability, with increasing difficulty of the task included to further increase ability (19).

Determining the motivation to participate and the motivation to perform effectively is a complex endeavour. Although the current study did not employ a direct measure of activity motivation, based on the nature of the activities, the low-organized games program participants may have experienced greater motivation. For example, unlike many competitive sport-based programs, low-organized games programs typically are inclusive and reduce, remove, or de-emphasize the concepts of winning and elimination from game-play. The increased emphasis on participation rather than winning or losing, may improve the overall experience and continued motivation to participate. With little to no negative experience of “losing” the low-organized game participants may be more motivated to participate, as well as take advantage of future opportunities to play the games. In particular, games that combine cooperation and competition appear to promote the highest level of intrinsic motivation, which should be considered in future investigations (28). As well, low-organized games programs typically allow all participants to play all roles within game play (i.e., every player is required to throw, catch, run and jump), which may provide more opportunities to practice a variety of FMSs. Additionally, with all players engaged in the activity at once, there is likely less concern that one’s ability to perform skills are being watched or revealed, increasing the likelihood that the skill will be practiced. Utilizing the elements of low-organized games when planning future research studies, as well as providing program leaders training on the potential benefits of these games, may aid in motivating children to practice and perform skills fully.

Feedback, direct or indirect, as well as the impact of it was not measured during the program. That said, the use of effective feedback, as well as program leaders’ ability to provide effective feedback has an important role in skill acquisition in children. One particular study found that children who received more feedback performed better than children who received less feedback (27). Another study found that feedback during successful trials, as opposed to less successful trials was beneficial in improving performance and motivation in children (22). These two small pieces of information: providing more frequent feedback and providing positive feedback after successful skill attempts, rather than feedback regarding unsuccessful skill attempts, could assist program leaders in guiding skill acquisition. Developing training that stresses the importance of effectively timed and motivating feedback may benefit future interventions aimed at improving FMS and ultimately physical activity participation rates in children and youth.

Participants from the low-organized games and sport-based programs attended other structured physical activity programs in addition to their after school programs discussed in this study. Wide variation was seen in the types of other programs the participants attended, including sport programs such as ice hockey and soccer, as well as dance, gymnastics, swimming lessons and martial arts. Given the similarity in the variety of programs both groups attended as well as the similar amount of time spent in these programs by both groups, it is not likely that participation in other programs explains the improvement in FMS of the low-

organized games-based program participants.

Overall, participants of both programs had poorly developed FMS as noted by low percentile ranking (21 to 27th percentile at post-test) on the TGMD-2. This is in keeping with previous research indicating that the current population of children are typically performing FMS at low mastery levels (8, 15, 20, 34). Normative data for the TGMD-2 was collected in 1997-1998, 14-15 years prior to the data collection for this research project. Previous studies also suggested children are performing FMS at a lower level than children 5-10 years ago (20, 30). The low FMS mastery seen in this study and previous initiatives is thought to be linked to overall low-levels of engagement in physical activity in the population (8, 15, 20). While the current research project provides some data that can be generalized to Canadian children, surveillance of FMS proficiency in population wide studies, such as the Canadian Health Measures Survey and National Health and Nutrition Examination Survey are necessary to better understand FMS proficiency of Canadian and American children.

The current study utilized a small sample size (n=40), which may have impacted the between-group comparisons, particularly as the sports-based program participants consisted of only 14 children. Specific and regular measures of feedback, motivation and practice were not obtained, which would have provided richer context to the results of this study. The results of this research project are limited to the two specific after-school programs measured. As well, the participants of the low-organized games program attended the program at their school; therefore, the

increase in FMS may be attributed to the individual school's PE program. That said, all children participating in this study attended public schools in the Halifax Metro Region, which follow the same curriculum guidelines as set forth by the Nova Scotia government. Assigning program participants to after school program type randomly would prevent this limitation in future studies. Further research is needed to determine if the findings of this study generalize to a wider population.

Program attendance may have also impacted the influence of the programs, as the low-organized games program participants were registered in the program for 5 days of the school-week, versus the sport-based program participants who were registered an average of 3.67 days per week. The low-organized games-based program participants may have had greater exposure to their after school program, increasing opportunities for engaging in program content. Attendance was not mandatory at either program; therefore registration may not be reflective of actual program attendance, and further research studies should consider collecting this data. There is a possibility that the sports-based program participants experienced an artificial ceiling effect in their GMQ scores and required higher levels of skill engagement to further develop their skills, given recent evidence that there has been a population wide decline in FMS mastery (7, 14, 18). Program participants in all likelihood have the capacity for increased motor skill proficiency given the low scores they received; however, current population FMS proficiency may not be greater than these scores, creating an artificial ceiling effect. With no Canadian data to support

population wide low-levels of FMS, and the normative data for the TGMD-2 obtained in 1998-1999 from US children this cannot be confirmed.

Significant improvement in FMS proficiency was found in the 6 to 10 year old participants after 11 weeks of participation in the low-organized games program. No significant differences in change were seen between the low-organized games and sports-based program participants in FMS proficiency. Study limitations may have impacted significance comparison of the between group results of this project. Elements of low-organized games programming may be beneficial in improving motivation; however, further research exerting greater control over programming is needed to gain deeper understanding of how and what type of low-organized games may promote FMS development before a wide-spread promotion and implementation of such programming is undertaken.

Future research initiatives should continue to measure the effectiveness of after school care programs on the development and acquisition of FMS utilizing better control of program structure and randomization of program participants. A measure of effective feedback utilized by program leaders should be included to understand how this contributes to FMS development. Individual characteristics, training experiences and ability to implement the programming should be measured to better understand how program leaders support motor skill development in program participants. Opportunities to practice skills should also be assessed, including frequency of skill performance, as well as percentage of time spent on task. As well,

participant motivation should be measured to determine if low-organized games programming enhances motivation to participate in physical activities. Providing specific training to program leaders on FMS acquisition, incorporating the principles of effective feedback, practice time and type, and motivation should be considered. Continued improvement of after school programming, and the capability of programs to support FMS development, may assist in engaging the population in lifelong health promoting physical activity.

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