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ORIGINAL ARTICLE

Fundamental movement skills proficiency amongst neurotypical grade one children in Cape Town, South Africa

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Abstract

Globally, there is a growing need to recognise and realise the importance of physical activity (PA). For children to be active, they need to be proficient in fundamental movement skills (FMS) because these skills serve as the building blocks for more specific and complex movements later in life. To date, no previous study has investigated the FMS proficiency of children in the Western Cape, South Africa (SA). This study investigated the FMS proficiency of Grade 1 children ($N=178$) from two schools in Cape Town (SA) using the Test of Gross Motor Development-2 (TGMD-2). The results indicated that 35% of the participants mastered all their FMS. Generally, children performed better in locomotor than object control skills, however, no statistically significant differences were found in locomotor skills between boys and girls. There was a statistically significant difference ($p=0.01$) in object control skills, where boys performed better than girls. The results indicated that run was the highest mastered skill and hop the most difficult to master. The greatest difference between boys and girls was in kick and roll, where boys performed better. Although the results look seemingly good in comparison to international studies, it is recommended that children should continue to practice their FMS, especially strike, hop, leap and gallop, as they were the most difficult skills to master. These results highlight the importance of FMS proficiency and describe the proficiency of Grade 1 children in a selected area in the Western Cape.

Keywords Motor competence · Physical activity · Mastery · Locomotor · Object control · Grade 1 learners

Introduction

The holistic benefits of participation in physical activity (PA) for health, physical, social and cognitive development during childhood are well established [1]. PA allows children to move their bodies through space at different levels, develop gross motor skills, have fun, learn in structured settings and enjoy free play. However, to be physically active, children need to be competent in performing fundamental movement skills (FMS) [2]. FMS refer to the ability to execute locomotor (running, hopping and jumping), object control (striking, catching and kicking) and stability skills (balancing and twisting). These skills are considered the building blocks for more complex movements and skills later in life [3].

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However, FMS do not develop naturally as is generally believed [4]. In order for children to move towards a positive trajectory of FMS development, these skills need to be taught, continuously practised and refined, alongside appropriate feedback from teachers, parents and coaches [2, 4, 5]. In this context, the age range 2–7 years is identified as the key developmental phase for the development of FMS within the Hourglass Model of Motor Development [3]. According to this model, children in this phase need to specifically focus on, and develop their FMS, build on their rudimentary movement phase (which is the phase before FMS begin to develop), and prepare for movements that are more specialized. Children should also have the potential to master FMS by the age of seven [3].

The importance of competence in FMS among young children has been widely acknowledged [4, 6–8]. However, most studies report low levels of FMS proficiency among young children and that mastery of FMS at these ages suggested by theoretical models, such as the Hourglass Model of Motor Development, are not reached [2, 4–6, 8–12]. Low FMS competence levels are of concern as FMS also have

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a strong influence on children's social, cognitive and emotional skills [4]. Furthermore, a lack of proficiency in FMS can potentially lead to physical inactivity [7]. Therefore, to ensure that strategies can be put in place to enhance FMS where needed and to avoid children developing a proficiency barrier towards subsequent health-enhancing PA [6, 13], it is important to monitor FMS levels across contexts and cultures. It is necessary to understand the FMS proficiency of South African children as well as to know where the children are with their initial FMS development to ensure that interventions are correctly implemented and to eliminate any cultural sensitivity. Although the aforementioned research indicated that many children were not as proficient in their FMS as expected, it is important to note that the majority of these studies have been conducted in the UK, Ireland, Singapore and the US [2, 4–6, 8–12], and that the findings are not transferable to other countries because of geographical and cultural differences. Therefore, it is important to collect data in South Africa to gain a better understanding of the specific intervention programmes to get children more proficient.

To date, no study has examined the FMS proficiency of Grade 1 children in Cape Town, South Africa. Understanding this issue is important for public health specialists and educationalists. Although Physical Education (PE) is still part of the South African school curriculum, schools are progressively disinvesting in PE, resulting in children getting fewer opportunities to practise and develop their FMS [14]. Without understanding how proficient South African children are in their FMS, evidence-based intervention strategies to improve children's holistic development through FMS will not be possible. Consequently, the current study addresses this gap and: (a) determines the FMS proficiency of a sample of South African children in Grade 1 (between 6 and 8 years old), and (b) examines differences in FMS proficiency between boys and girls.

Method

Participants

This study followed a descriptive study design and a sample of convenience was selected from two schools in the Bellville and Stellenbosch regions, South Africa. Grade 1 children ($N = 178$; $n = 98$ boys and $n = 80$ girls) ($M = 6.7$, $SD = 0.43$) volunteered to participate in the current study. Written consent from the parents or legal guardians and assent from the children were obtained prior to participation. All participants were free of any neuromuscular disorder or special education needs, which could impede movement (information was retrieved from the teachers at the specific schools). Following institutional approval (#8456) from the Research Ethics Committee of the Institution involved and the Western Cape Education Department (WCED), the researcher approached the school to take part in the study.

Procedures and assessments

All tests took place in the schools' halls at stations (eight children per station) allocated for the various assessments. Children undertook measurements in a standardised order, comprising of FMS. Children were assessed according to the guidelines as stated in the TGMD-2 scoring sheet. Children received a number for all the assessments to ensure that every child completed the assessment and to ensure anonymity.

Fundamental movement skills

The Test of Gross Motor Development-2 (TGMD-2) was used to assess the FMS [15]. The TGMD-2 assesses proficiency in two motor area composites, namely locomotor and object control. Locomotor skills consist of run, hop, horizontal jump, leap, gallop and slide. Object control skills include striking a stationary ball, stationary dribble, catch, overhand throw, kick and underhand roll. A clear demonstration was given for each skill and participants performed one practise trial per skill and two formal test trials as indicated in the TGMD-2 protocol manual [15]. The scores of the two formal test trials created a raw score for each skill. For run, jump, slide and gallop, participants were able to score between 0 and 8, for leap between 0 and 6 and for hop between 0 and 10. In striking, dribble, kick, throw and roll between 0 and 8 and for a catch between 0 and 6. Scores for run, hop, horizontal jump, leap, gallop and slide were summed to create a locomotor subtest score of 0–48. Scores from striking a stationary ball, stationary dribble, catch, overhand throw, kick and underhand roll were summed to create an object control subtest score of 0–48. The two subtest scores were calculated according to the TGMD-2 guidelines to create a total FMS score. Performances of each skill were video recorded using Samsung tablets (CE0890). On completion, the videos were transferred to a memory stick and slowed down to assess the FMS on a computer. In line with prior research [5, 16], FMS were scored by five assistants who received prior training on TGMD-2 scoring. Experienced Kinderkineticists performed the inter-rater reliability analysis for the TGMD-2. The intra-class correlations (ICC) agreement for the final locomotor and object control scores (combined) were 0.88 and the Kendal W, 0.9.

Data analysis

The descriptive statistics of each FMS and the related performance criteria were scored according to the specific TGMD-2 protocol [15]. To determine FMS proficiency,

previous protocols from Duncan et al. [5] and O'Brien et al. [4] were followed: (a) "mastery" was described as the correct performance of all the skill criteria of both formal trials, (b) "near mastery"(NM) was described as the correct performance of all criteria except one on both formal trials; (c) "poor" was described where the performance was incorrect in two or more of the criteria of both formal trials [5]. The number of participants that achieved "mastery", "NM" and "poor" were calculated for each skill. For example,if a child received 8 out of 8 for run, mastery was achieved, 6 or 7 out of 8 was near mastery and 0–5 out of 8 was poor. A binary variable was determined for "mastery" and "NM" for each skill of the TGMD-2 and described as "near mastery" [4]. The raw scores for the TGMD-2 skills were categorised according to levels of mastery, namely "mastery", "near mastery" and "poor", which were coded as "1" (mastery and near mastery) and poor as "0" [5]. The percentage of participants who achieved mastery, near mastery and poor for each skill was determined. Comparisons between boys and girls for continuous variables were performed using one-way ANOVA. Normal probability plots were inspected for normality and were mostly found to be acceptable. Levene's test was used to check for homogeneity of variance. The subjects were included in the model as a random effect and skill and gender as fixed effects. Post hoc testing was done using Fisher's least significant difference (LSD testing. Categorical mastery outcomes were compared between boys and girls using cross tabulation and the Chi-Square test. In cases where "small (≤ 5" cell frequencies were found,the generalized Fisher Exact test was done. Data were analysed using Excel (Microsoft® and Statistica version 13.5 (TIBCO Software Inc., Palo Alto, California, USA.

Results

Fundamental movement skills

The final sample for the study consisted of $N = 178$ participants (55% boys and 45% girls) and ages ranged from 6 to 8 years. The TGMD-2 skills were divided into three categories, namely: "mastery", "near mastery" (NM) and "poor". In the current study, 35% of the participants mastered all the FMS, 37% were at the NM level and 28% did not master any of the skills (poor). In addition, 37% mastered locomotor skills, 34% achieved NM and 30% were poor. Regarding the object control skills, 33% achieved mastery, 41% NM and 26% poor. Table 1 displays the mean and SD for the total FMS score, total locomotor and object control scores for all the participants and for boys and girls separately.

Figure 1 displays the proficiency levels of all the TGMD-2 skills (locomotor and object control) for the boys and girls together. The highest mastered locomotor skill was running (67%) and the least mastered skill was hopping (16%).

Table 1 Mean and SD for total FMS scores

Skill	Mean	SD	Cohen's *D* effect sizes
Total FMS Score (0–96)	73	4.4	Small
Total Locomotor Score (0–48)	36	2.5	Negligible
Total Object Control Score (0–48)	37	1.9	Small
Total locomotor (boys) (0–48)	36	2.6	Negligible
Total locomotor (girls) (0–48)	36	2.4	Negligible
Total object control (boys) (0–48)*	39	1.9	Small
Total object control (girls) (0–48)*	36	1.9	Small

*Statistical significant difference

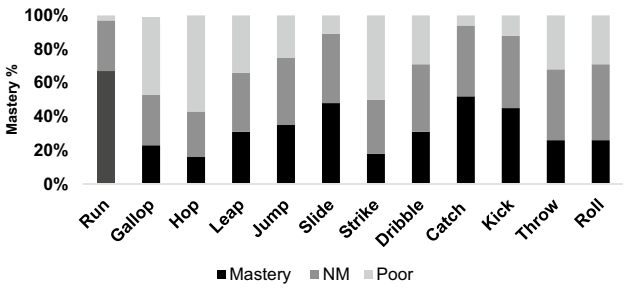

Fig. 1 FMS proficiency of the whole sample

In object control, the highest mastered skill was catch (52%) and the least mastered skill strike (18%).

Regarding the differences between the raw scores of locomotor and object control skills between boys and girls, the data showed no statistically significant difference in the locomotor scores ($p > 0.05$). Conversely, regarding object control skills, a difference ($p = 0.01$) was found; boys had a higher mean score than girls (boys had a mean score of 39 and girls 36) (Table 1). The results depict a difference for kicking ($p = 0.01$) and striking ($p = 0.01$) between boys and girls, where boys performed better. As depicted in Figs. 2 and 3, sex played no role in most of the FMS. According to the results, boys and girls had very close mastery scores in locomotor skills. In object control skills, there were more differences between boys and girls. In striking a stationary ball, 22% of the boys and 13% of the girls demonstrated mastery. Dribble, catch and roll showed no sex difference; however, the catch was the best mastered skill and the only skill where girls performed better than boys. A statistically significant difference between boys and girls ($p = 0.03$) was shown in the throw between boys and girls; 33% of the boys and 18% of the girls mastered throw.

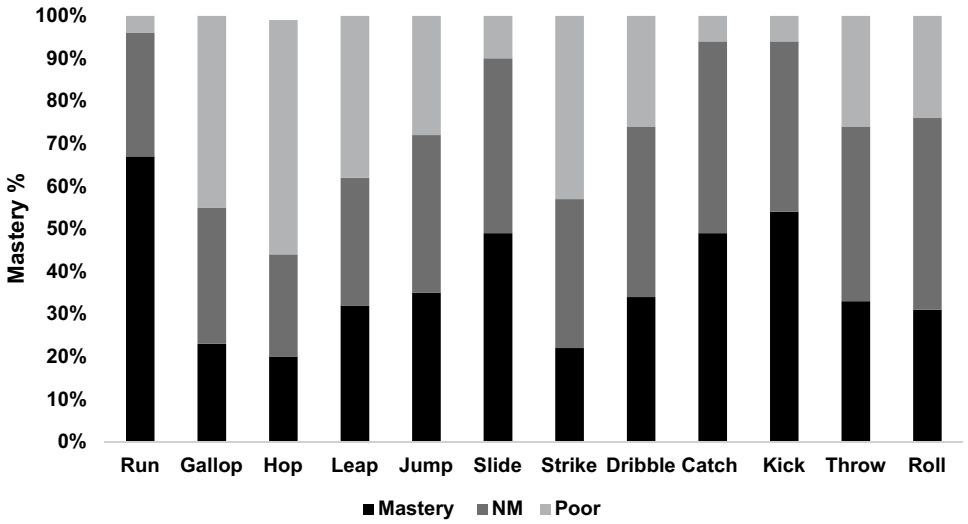

Fig. 2 FMS proficiency for boys

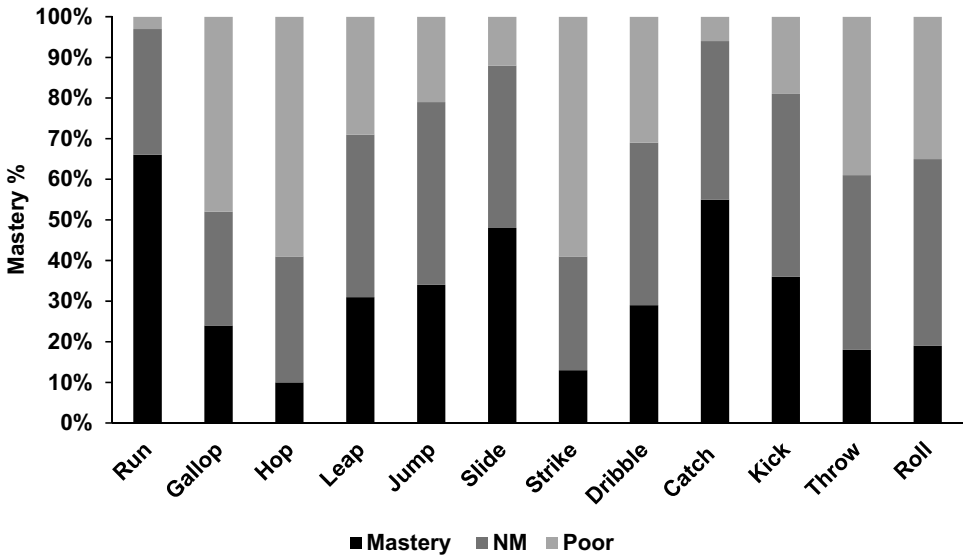

Fig. 3 FMS proficiency for girls

Discussion

The current study is the first to present data on FMS proficiency in the Western Cape for children aged between 6 and 8 years old. The key findings of the present study were that FMS proficiency of this sample of children were relatively good for their age, as 35% of the total sample mastered their FMS, 27% achieved NM and 28% did not master their FMS at all, studies of Mukherjee et al. [2] and O'Brien et al. [4] found lower results in the total mastered skills, NM and poorly mastered. It is positive that over a third of the children mastered their FMS between 6 and 8 years old, however, nearly a third have not mastered their FMS. Globally, it is expected that children should be able to master their FMS between the ages of 4–6 years old. By the time they go to primary school, they should exhibit age-appropriate mastery of locomotor and object control skills [17]. Nevertheless, researchers have found that these assumptions are not in line with children's skills at that age [2]. There were no statistically significant differences between the overall locomotor and object control skills proficiency levels in the current study, but participants performed better in locomotor skills.

Differences can be seen between skills in children as well as differences between boys and girls. Locomotor skills like leap, gallop and hop are more difficult to master, as it requires much more coordination, rhythm and timing to execute. On the other hand, object control skills such as striking a ball, roll and throw also demand more technique as one's body need to rotate and the legs need to be in coordination with the arms. However, according to Gallahue and Ozmun

children need to be able to master these skills and therefore more attention needs to be given to specific skills.

Although the children performed better in their locomotor skills, according to Westendorp et al. [18], young children's locomotor skills are underdeveloped because they require simultaneous coordination from the left and right sides of the body, which makes the skill more difficult to execute. The study done by Bryant et al. [10] also supports the findings of Westendorp et al. [18]. The current study is in support of the findings of Mukherjee et al. [2] who investigated the FMS proficiency of 6- to 9-year-old Singaporean children ($N=244$). The highest mastered skill was run and the least was hop, which is in line with the current study. Halverson and Williams, 1985 concluded that the ability for children to hop requires a good amount of force to lift their bodies from the ground, propel upwards into flight and immediately to balance their body on one leg when they land. In the TGMD-2 specifically they need to complete three consecutive hops and change over to the other leg in the same motion, and therefore they need timing and coordination which makes this skill more complex. Pienaar et al. [19] explored the differences in FMS between 6-year-old boys and girls ($N=72$) and concluded that run was the highest mastered skill. Therefore, the researcher can conclude that the highest mastered skill and most difficult skill to master was locomotor skills. The study done by Pienaar et al. [19] only evaluated catching, kicking and throwing, and found that throwing was the least mastered object control skill and catching the highest mastered skill. Compared to the current study, catching was also the highest mastered skill. The study done by Mukherjee et al. [2] also found catch was the highest mastered skill and roll the least mastered skill.

No sex differences overall in locomotor and object control were seen in the current study, which is in line with the study done by Mukherjee et al. [2] and Roscoe et al. [20]. Statistically significant sex differences ($p<0.01$) in the current study were only found in two object control skills, namely kick and throw, in which boys had higher proficiency scores than girls. These findings correspond with those of Bryant et al. [10] who investigated the FMS and weight status of 6- to 11-year old British primary school children ($N=281$). The study of Pienaar et al. [19] concluded that boys showed a higher percentage of mastery in object control skills and that there was a statistically significant difference between boys and girls in kick. In the present study, catch was the only skill that girls mastered better than boys, which is contradictory to Hardy et al. [21], who concluded that boys outperformed girls. The studies of Foulkes et al. [11], Hardy et al. [22], Pang and Fong [23] and Bryant et al. [10] reported that boys performed better than girls in object control skills, such as strike, kick, dribble, throw and catch. It could be speculated that boys prefer to play ball games for structured activities, as well as during free play, and therefore, increase the mastery of object control skills [2].

Socio-cultural, environmental and geographical factors and differences could result in differences in FMS proficiency and sex differences in skills as well as differences between South African and International studies [5]. However, Malina et al. [24] concluded that children in the primary school age are mainly in the pre-pubertal maturational phase, and therefore, boys and girls should be more or less on the same level of proficiency. Boys performed slightly better in certain skills than the girls, which should be taken into consideration when working with children to increase their FMS proficiency. The majority of the present study's findings are comparable with the findings of Pienaar et al. [19], which is the only other study that has been done in South Africa on the FMS proficiency of 6-year-old children. The result of the current study was drawn from 6- to 8-year-old children in only two schools in the Bellville and Stellenbosch regions of Cape Town, and therefore it cannot be generalised. Although the schools were broadly indicative in the province, it can be recommended that future research should examine a larger number of children in a wider area.

Limitation

There is no recent and relevant data in South Africa on the FMS proficiency and that made it difficult to compare the current results in a South African context. The TGMD-2 does not evaluate stability and this can be recommended to investigate in future studies. The inter-rater reliability of the TGMD-2 object control subtest had a very low score and this needs to be revised in the future.

Conclusion

The study found that over a third of the Grade 1 children aged between 6 and 8 years old mastered their FMS and almost a third remained in the 'poor' category. Run and catch were the two easiest skills to master, while leap and gallop were the most difficult, providing a clear indication of focus for future FMS interventions. Significant differences were seen between boys and girls in kick, strike and throw with the boys performing better. There are important practical applications resulting from this study, children should participate more in specific locomotor skills, such as gallop, hop and leap and practise, coordination and rhythm. More emphasis needs to be placed on strike, throw and dribble as it would help children to improve their overall FMS proficiency levels. Girls should focus more on kick, roll, throw and strike as they fared poorly in these skills. The abovementioned skills are not necessary skills that children would

execute while they participate in free play, and therefore, children should be motivated and encouraged to participate in more specific skills to reach mastery in FMS. Children need to develop and learn FMS, and the school setting can be the ideal environment to get exposure to these skills. Teachers, coaches, parents, therapists, government and school bodies should use these results to develop specific intervention programmes that can improve FMS proficiency whilst keeping sex differences in mind.

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Declarations

Conflict of interest The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Ethical approval and informed consent This study followed a descriptive study design and a sample of convenience was selected from two school in the Bellville and Stellenbosch regions, South Africa. Grade 1 children ($N = 178$; $n = 98$ boys and $n = 80$ girls) ($M = 6.7$, $SD = 0.43$) volunteered to participate in the current study. Written consent from the parents or legal guardians and assent from the children were obtained prior to participation. All participants were free of any neuromuscular disorder or special education needs, which could impede movement (information was retrieved from the teachers at the specific schools). Following institutional approval (#8456) the study was conducted according to the guidelines of the Declaration of Helsinki and the Western Cape Education Department (WCED), the researcher approached the school to take part in the study.

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