

Original article

Fundamental movement skills training to promote physical activity in children with and without disability: A pilot study

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Abstract

Background: A positive association between fundamental movement skills (FMS) and physical activity (PA) has been shown in previous research of children with and without disability. This pilot study explored a causal mechanism for such relationship, and hypothesized that when FMS proficiency is improved, enhanced PA uptake will be found in children with and without disability. It was further hypothesized that improving FMS proficiency will have a greater impact on children with disability than those without disability.

Methods: Participants include typically developing (TD) children without disability and children with cerebral palsy (CP), who were allocated to FMS training groups (CP-FMS $n = 12$, TD-FMS $n = 13$) and control groups (CP-C $n = 12$, TD-C $n = 13$). Training groups practiced five FMS (run, jump, kick, throw, catch) in weekly 45-min sessions for 4 weeks. Control groups had their regular physiotherapy (CP) or physical education (TD) sessions. FMS were evaluated using process- and product-oriented measures, and PA was measured using accelerometers, before and after training.

Results: It was verified that training groups gained improvements in FMS while control groups did not. No significant changes in weekday PA were found. Increased weekend moderate to vigorous physical activity (MVPA) was found in the CP-FMS group, while decreased weekend sedentary time was found in the CP-FMS and TD-FMS groups. The percentages of participants who exceeded the minimum detectable change (MDC₉₀) in MVPA and sedentary time were larger in children with CP than in children without disability.

Conclusion: The findings suggest that improved FMS proficiency could potentially contribute to heightened PA and decreased sedentary time during weekends for children. Such effect of improved FMS proficiency on PA appears to be greater in those with physical disability than in those without disability. It is recommended that the findings of this pilot study should be further examined in future research.

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Keywords: Cerebral palsy; Fundamental movement skills; Motor learning; Physical activity; Sedentary behavior

1. Introduction

Physical activity (PA) has been deemed important in child development due to its associated positive outcomes in

terms of musculoskeletal and cardiovascular health, socialization, and discipline.^{1–3} The World Health Organization (WHO) recommends that young people should accumulate at least 60 min of moderate to vigorous physical activity (MVPA) daily.⁴ Children with physical disabilities tend to have lower PA levels compared to those without disability, as has been shown in those with cerebral palsy (CP).^{5,6} Children with CP are affected by impairments that hinder

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their ability to move and control posture,⁷ potentially impacting PA participation.

In children without disability, fundamental movement skills (FMS) proficiency has been found to be positively associated with the time allocated to PA. Children who have greater FMS proficiency tend to be more active.^{8–11} FMS consist of locomotor and object control skills that form the basis of movement skills that are used in sports and games¹² and are believed to develop the foundations of PA patterns that persist throughout a lifetime.¹³ In children with CP, gross motor function has been suggested to be one of the important factors that influence PA participation,¹⁴ possibly as a consequence of delayed FMS development associated with motor impairments.

The relationship of FMS with PA can be understood through the International Classification of Functioning, Disability and Health (ICF) model for children and youth.¹⁵ The ICF model is considered as the universal framework to describe function, health, and disability and categorizes human function under three components: body functions and structures, activities, and participation.¹⁶ In children, the relevant body function is the motor ability of a child, which could be affected by developmental delay as in the case of those with CP. FMS are complex skills that fall under the activity component, while PA level represents a participation component. The bi-directional relationship of ICF components suggests that targeting the FMS proficiency of children could generate positive effects on their PA engagement. Such relationship may be affected by developmental delay due to a physical disability. As such, this study piloted an FMS training program and examined one direction of a causal relationship between FMS proficiency and PA engagement in two groups of children: those with CP and those without disability. It was hypothesized that, if FMS has a causal relationship with PA, there will be an increase in PA after effective FMS training. Considering the impact of physical disability on FMS development and PA participation, our second hypothesis was that implementing FMS training will have a greater impact on PA among children with disability than those without disability.

Evidence-based recommendations have highlighted that movement skills training should be based on a sound theoretical framework.¹⁷ In this study, the FMS training program was based on the errorless motor learning model,¹⁸ which constrains the environment to minimize the amount of practice errors. It has been suggested that reduction of practice errors facilitates movement performance that is stable even when doing a secondary cognitive task (i.e., dual-task demands).¹⁸ Subsequent studies also revealed advantages such as stability against physiological fatigue, long-term skills retention,¹⁹ and superior movement performance.²⁰ Besides those advantages mentioned, this approach was chosen because it is believed that greater experiences of success during practice could promote heightened self-efficacy among children.

This model was applied in a recent study of children without disability where overhand throwing practice was integrated into physical education (PE) lessons in a primary

school.²¹ Task difficulty was manipulated so that learners began with an easy task that progressively increased in difficulty, thereby minimizing practice errors in the early stage. It was shown that reduction of errors in the initial stages of learning resulted in improved movement performance that were unaffected by cognitive dual-task demands. This suggests that children learnt motor skills without significantly relying on their cognitive resources. In a follow-up study, a similar overhand throwing practice program was integrated into the adapted PE lessons of children with intellectual disability.²² Besides the consistent findings of improved movement proficiency and stability in the presence of secondary cognitive tasks, heightened free play engagement when the skill was relevant (i.e., throwing games) was also observed. Based on these recent researches, the errorless learning approach was deemed to be an appropriate framework for FMS training of children with and without disability. It appears that this approach could accommodate learners' variations of ability, and was thus used in this pilot study.

2. Methods

2.1. Participants

In the first study group, children with CP were recruited from a pediatric therapy clinic ($n = 24$; 12 girls, 12 boys). To prevent experimental contamination, participants were allocated by group (i.e., those in the clinic at the same schedule were allocated as a group to either training or control) into either an FMS training group (CP-FMS; $n = 12$; mean age: 6.92 ± 3.04 years) or a control group (CP-C; $n = 12$; mean age: 7.98 ± 1.74 years). The children with CP were within Gross Motor Classification System (GMFCS) levels I to III. There were six children in GMFCS level I (2 CP-C, 4 CP-FMS), 14 in GMFCS level II (7 CP-C, 7 CP-FMS) and four in GMFCS level III (2 CP-C, 2 CP-FMS). Two-way chi square analysis showed no significant differences in the distribution between groups (CP-FMS vs. CP-C) and between GMFCS levels ($\chi^2 = 1.67$, $df = 2$, $p = 0.435$).

For the second study group, two classes of typically developing (TD) children without disability were recruited from a primary school ($n = 26$; 13 girls, 13 boys) and were allocated to either FMS training (TD-FMS; $n = 13$; mean age: 7.17 ± 2.77 years) or control (TD-C; $n = 13$; mean age: 6.82 ± 2.51 years). All participants from both groups met the following inclusion criteria: (1) no known health conditions that were contraindicated to engagement in moderate PA, (2) able to follow a minimum of 2-step commands, (3) gave verbal assent, and (4) returned signed parental informed consent. No significant differences were found in the age and BMI of the study groups.

2.2. Design overview

This pilot study used a pre–post-test design over a period of 8 weeks. Each participant completed 1-week

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