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Getting the fundamentals of movement: a meta-analysis of the effectiveness of motor skill interventions in children

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Abstract

The development of fundamental movement skills (FMS) is associated with positive health-related outcomes. Children do not develop FMS naturally through maturational processes. These skills need to be learned, practised and reinforced. The objective was to determine the effectiveness of motor skill interventions in children. The following databases were searched for relevant articles: Academic Search Premier, PsycArticles, PsycInfo, SportDiscus and ERIC. No date range was specified and each search was conducted to include all possible years of publication specific to each database. Key terms for the search included motor, skill, movement, intervention, programme or children. Searches were conducted using single and combined terms. Pertinent journals and article reference lists were also manually searched. Inclusion criteria: (1) implementation of any type of motor skill intervention; (2) pre- and post-qualitative assessment of FMS; and (3) availability of means and standard deviations of motor performance. A significant positive effect of motor skill interventions on the improvement of FMS in children was found ($d = 0.39$, $P < 0.001$). Results indicate that object control ($d = 0.41$, $P < 0.001$) and locomotor skills ($d = 0.45$, $P < 0.001$) improved similarly from pre- to post-intervention. The overall effect size for control groups (i.e. free play) was not significant ($d = 0.06$, $P = 0.33$). A Pearson correlation indicated a non-significant ($P = 0.296$), negative correlation ($r = -0.18$) between effect size of pre- to post-improvement of FMS and the duration of the intervention (in minutes). Motor skill interventions are effective in improving FMS in children. Early childhood education centres should implement 'planned' movement programmes as a strategy to promote motor skill development in children.

Introduction

One component of physical development is the learning of fundamental movement skills (FMS). FMS require the activation of large muscle groups and are typically classified as object control and locomotor skills (Haywood & Getchell 2009). Object control skills involve the transporting, intercepting or projecting of objects such as throwing, catching, dribbling, kicking, underhand rolling and striking. Locomotor skills include running, jumping, hopping, leaping, galloping and sliding as different movements to transport the body from one location to another (Ulrich 2000). The development of FMS allows children to independently navigate their environment (Clark 2007; Robinson & Goodway 2009) and contributes to the overall health of children (Piek *et al*. 2008).

Fundamental movement skills are the building blocks of more complex movements (Seefeldt 1980; Clark & Metcalfe 2002). The early childhood years are a critical time for their development (Clark 1994). FMS enable children to apply basic motor skills to participate in sports and games that require more advanced movements during the school-age years and throughout the lifespan (Clark 1994). For example, to participate in a game of baseball or softball, individuals need basic competence in running, catching, throwing, and striking. Evidence supports the association between FMS competence and physical activity (Okely *et al.* 2001a; Fisher *et al.* 2005; Morgan *et al.* 2008; Williams *et al.* 2008; Houwen *et al.* 2009; Robinson *et al.* 2011). Emerging evidence also suggests that overweight or obese children tend to exhibit less competence of FMS (Graf *et al.* 2004; Williams *et al.* 2008; Logan & Getchell 2010; Logan *et al.* 2011a) and are less physically active (Trost *et al.* 2003; Bayer *et al.* 2008; Robinson *et al.* 2011). Thus, the development of FMS in children could play a pivotal role in the prevention of childhood obesity.

Approximately 58.2% of children 3 to 5 years old in the USA are enrolled in a pre-school or early learning centre (U.S. Department of Education 2009). These centres are an appropriate environment to facilitate FMS competence through structured movement programmes. The National Association for the Education of Young Children is the largest organization concerned with the well-being of children and the quality of early childhood education programmes (National Association for the Education of Young Children 2010). To meet accreditation standards, children are required to be provided opportunities and equipment to engage in a variety of motor experiences. Often, free play is the only opportunity children have to engage in movement activities and while this may encourage movement, it does not promote the learning of FMS (Gagen & Getchell 2006). Although the term development may imply that FMS competence is acquired 'naturally' through maturational processes, this is not the case (Clark 2005). These skills need to be learned, practised and reinforced (Goodway & Branta 2003; Valentini & Rudisill 2004a; Robinson & Goodway 2009). Motor skill interventions consist of planned movement activities that are developmentally and instructionally appropriate. Thus, there is a need for research to determine the effectiveness of motor skill interventions relative to free play experiences to improve FMS competence. One method to synthesize research findings across a variety of studies is to conduct a meta-analysis. To our knowledge, no systematic reviews or meta-analyses have examined the effectiveness of motor skill interventions to promote FMS competence in children.

Researchers use a variety of motor assessments when measuring pre- to post-intervention changes in FMS competence. Assessments use either a product- or process-oriented approach to evaluate movement performance. A product-oriented assessment evaluates movement on the outcome. This type of assessment provides little information with regard to *how* the movement was performed. In contrast, a process-oriented assessment evaluates movement based on the demonstration of behavioural criteria, which provides information of how the movement was performed and allows teachers to identify specific aspects of movement for each child that need to be improved upon. Recently, researchers have questioned the generalizability of results across studies that use different types of motor assessments (Stodden *et al.* 2008). In addition, there is confusion in the literature regarding the operational definition of FMS. While some researchers use this term to describe general motor competence (Fisher *et al.* 2005; Ziviani *et al.* 2009), others reserve this term for the specific use of describing *skills* which directly apply to participation in physical activity (Clark & Metcalfe 2002; Haywood & Getchell 2009). Due to this discrepancy in the literature, an inclusion criterion of the present study was the use of a qualitative (process-oriented) FMS assessment.

There is a need to understand the effectiveness of motor skill interventions. Thus, there were three main objectives of this meta-analysis: (1) to determine the overall effect of motor skill interventions on the improvement of FMS competence in children; (2) to determine if interventions were similarly effective in improving object control and locomotor skills; and (3) to determine the association between the duration (in minutes) of an intervention and improvement of FMS competence.

Methods

The following databases were searched for relevant articles: Academic Search Premier, PsycArticles, PsycInfo, SportDiscus and ERIC. No date range was specified and each search was conducted to include all possible years of publication specific to each database. Key terms for the search included motor, skill, movement, intervention, programme or children. Searches were conducted using single and combined terms. Pertinent journals and article reference lists were also manually searched. Eleven studies satisfied the following inclusion criteria: (1) implementation of any type of motor skill intervention; (2) pre- and post-qualitative assessment of FMS competence; and (3) availability of means and standard deviations of motor performance. Due to the small number of studies that met the inclusion criteria, the presence of a control group was not necessary for inclusion. However, 6 of the 11 studies included a control group. For the purpose of this study, control groups were defined as free play conditions to engage in physical activity that did not include formal instruction of motor skills. Four studies included for analysis compared the effectiveness of different instructional approaches on the improvement of FMS competence. Thus, an experimental teaching approach (such as a child-centred or mastery approach) was compared against a traditional teaching approach (i.e. direct instruction). In these studies, there was not a control group that received no instruction; however, the traditional teaching approach was used as a 'comparison' group. For analysis, if any type of instruction was provided it was included as a treatment group. Motor skill interventions included for analysis lasted 6–15 weeks and 480–1440 min of total intervention time. See Table 1 for a full description of studies included in the meta-analysis. In addition, there were 11 studies that mostly met the inclusion criteria but could not be included in analyses due to the lack of necessary information within the article. See Table 2 for a full description of these studies.

Studies included in the meta-analysis administered a qualitative (process-oriented) assessment of FMS. Results indicated that studies using the first and second edition of the Test of Gross Motor Development (TGMD; Ulrich 1985, 2000) were the only studies that met all of the inclusion criteria. Each edition includes an object control and a locomotor subscale. Locomotor skills include the run, gallop, hop, leap, jump, skip and slide. Object control skills include the strike, dribble, catch, kick and throw. The second edition removed skipping from the locomotor subscale and added the underhand roll to the object control subscale. Both editions of the TGMD are norm-referenced, process-oriented assessments that qualitatively assess skill performance and are validated for use in children between the ages of 3 to 10 years. Each skill is assessed by a child's ability to demonstrate three to five performance criteria. For example, one of the criteria for throwing is whether or not a child transfers weight by taking a step with the opposite foot of the throwing arm. There are many assessments that are designed to measure some aspect of motor competence; however, the TGMD *qualitatively* measures *skill* competence.

An effect size, which is a statistic that measures the strength of the relationship between two variables, was calculated for each subscale of the TGMD ($n = 21$) based on a standardized difference of paired means of pre- and post-assessment for each study using the Cohen's d-metric (Cohen 1969). Three studies reported total performance on the TGMD, without separate results for each subscale. Ninety-five per cent confidence intervals were calculated around mean effect sizes (see Fig. 1). If the 95% confidence interval does not include the value of zero, statistical significance at the 0.05 level has been established. In other words, a significant positive effect size shows that participation in a motor skill intervention significantly improved FMS. Separate meta-analyses were conducted to determine the cumulative effect of interventions on object control skills ($n = 12$), locomotor skills ($n = 9$) and both subscales of the TGMD, including studies that only reported overall performance ($n = 25$). Another meta-analysis was conducted to determine the effectiveness of the control groups to improve FMS competence. Since only six studies included a control group, the overall effect on total performance was calculated, without separate analyses for each subscale ($n = 9$). Given that studies included for all analyses consisted of a variety of intervention approaches, intervention providers and sample characteristics, a random effects model was used for all analyses (Hedges & Olkin 1985). All statistical analyses were performed with Comprehensive Meta-Analysis software, version 2.2. Alpha level for all analyses was set at 0.05 (Thomas *et al.* 2005).

Results

Children demonstrated significant improvements in FMS competence post intervention as measured by the TGMD. The overall effect size for the treatment groups was significant [$d = 0.39$; $n = 25$; $P < 0.001$; 95% confidence interval (CI) 0.23, 0.51; Fig. 2]. When considered separately, interventions resulted in significant and similar improvements in object control ($d = 0.41$; $n = 12$; $P < 0.001$; 95% CI 0.27, 0.55) and locomotor skills ($d = 0.45$; $n = 9$; $P < 0.001$, 95% CI 0.2, 0.7; Fig. 2). The overall effect size for control groups was not significantly different from zero ($d = 0.06$; $n = 9$, $P = 0.33$; 95% CI –0.06, 0.17; Fig. 2). A Pearson correlation indicated a non-significant ($P = 0.296$; $r = -0.18$) correlation between effect size of pre- to post-improvement of FMS and the duration of the intervention (in minutes; Fig. 3). Only treatment groups from studies included in the meta-analyses were used to calculate this correlation.

Discussion

The meta-analyses provide quantitative evidence that the implementation of motor skill interventions is an effective strategy to improve FMS competence in children. The overall effect size was moderate. This has two important implications. First, motor skill interventions provide children with basic FMS competence needed for more advanced movement. Second, given the evidence that less FMS competence is associated with less participation in physical activity and overweight or obesity, implementation of motor skill interventions may be at least part of a strategy to promote physical activity and prevent childhood obesity. However, these studies are based on correlations and results that should be interpreted with caution. Yet, despite the potential implications of these studies, very few early childhood education programmes provide developmentally and instructionally appropriate motor skill interventions for children (Gagen & Getchell 2006). More importantly, a non-significant effect of control groups (i.e. free play) lends greater support that

Table 1. Descriptions provided for each study included in the meta-analysis

Study	Intervention approach	Intervention provider	Intervention duration	Sample type	Sample size	Mean age (years)	Motor assessment	Score type	Effect size	Significant improvement (Y/N)	Random assignment
Apache (2005)	Child-facilitated	Researchers	15 weeks 1350 min	DD or at risk of DD	28	4.2	TGMD	Raw			Class level
							Locomotor		0.24	Y	
							Object control		0.49	Y	
	Direct instruction	Researchers	15 weeks 1350 min	DD or at risk of DD	28	4.2	Locomotor		0.18	N	
							Object control		0.05	N	
	No control group										
Cliff and colleagues (2007)	Mastery	Community-based. No further details provided	10 weeks 1200 min	Overweight/ obese children	13	10.4	TGMD-2	Standard	0.63	N	No
							GMQ			Y	
	No control group										
Goodway and Branta (2003)	Direct instruction	Researchers	12 weeks 1080 min	DD or at risk of DD	31	4.7	TGMD	Raw			Class level
							Locomotor		0.73	Y	
							Object control		0.72	Y	
	Control		Regularly scheduled free play	DD or at risk of DD	28	4.7	Locomotor		0.17	Y	
							Object control		0.33	Y	
Goodway and colleagues (2003)	Direct instruction	Researchers	9 weeks 630 min	DD or at risk of DD	33	4.9	TGMD	Raw			Class level
							Locomotor		0.45	Y	
							Object control		0.42	Y	
	Control		Regularly scheduled free play	DD or at risk of DD	30	5.0	Locomotor		0.01	N	
							Object control		0.04	N	
Hamilton and colleagues (1999)	Direct instruction	Parents	8 weeks 720 min	At risk of DD	15	3.9	TGMD	Raw			Class level
							Object control		0.33	Y	
	Control		Regularly scheduled free play	At risk of DD	12	4.0	Object control		−0.01	N	
Ignico (1991)	Direct instruction	Undergraduate students	10 weeks 480 min	Typically developing	15	4.9	TGMD	Standard		Y	Class level
							GMDQ		0.33		
	Control	Regularly scheduled free play			15	5.0	GMDQ		−0.03	N	
Martin and colleagues (2009)	Mastery	Researchers	6 weeks 900 min	At risk of DD	42	5.7	TGMD	Raw			Class level
							Locomotor		0.54	Y	
							Object control		0.23	Y	
	Direct instruction	Researchers	6 weeks 900 min	At risk of DD	22	5.4	TGMD-2				
							Locomotor		0.01	Y	
							Object control		0.12	Y	
	No control group										

Rintala and colleagues (1998)	Psychomotor training programme	Trained physical education and classroom teachers	10 weeks 1350 min	Developmental language disorders	38	8.1	TGMD GMDQ	Standard	0.08	N Y	No
	Physical education	Regular physical education	10 weeks 1350 min	Developmental language disorders	16	8.3	TGMD GMDQ		0.07	Y	
	No control group										
Robinson and Goodway (2009)	Mastery	Researchers	9 weeks 540 min	At risk of DD	39	4.0	TGMD-2 Object control	Raw	0.65	Y	Class/individual level
	Direct instruction	Researchers	9 weeks 540 min	At risk of DD	38	3.9	Object control		0.52	Y	
	Control	Regularly scheduled free play		At risk of DD	40	4.0	Object control		0.01	N	
Valentini and Rudisill (2004a)	Mastery	Researchers	12 weeks 1440 min	With and without disabilities	19 31	8.1 7.5	TGMD Locomotor Object Control	Standard	0.5 0.53	Y Y	Individual level
	Control		Regularly scheduled free play	With and without disabilities	17 37	8.0 7.4	Locomotor Object control			N N	
Valentini and Rudisill (2004b)	Mastery	Researchers	12 weeks 840 min	DD	19	5.5	TGMD Locomotor Object control	Standard	1.5 0.71	Y Y	Individual level
	Direct instruction	Researchers	12 weeks 840 min	DD	20	5.4	TGMD Locomotor Object control		0.87 0.73	Y Y	
	No control group										

DD, developmentally delayed in the motor domain; GMDQ, gross motor development quotient; GMQ, gross motor quotient (these are standard scores that represents performance on all skills); TGMD, Test of Gross Motor Development.

Table 2. Descriptions provided for each study that were not included in the meta-analysis due to a lack of reported data or were not published in a peer-reviewed journal

Study	Intervention approach	Intervention provider	Intervention duration	Sample type	Sample size	Mean age (years)	Motor assessment	Score type	Significant improvement (Y/N)	Random assignment	Reason(s) not included
van Beurden and colleagues (2003)	Nine intervention schools	Whole-school approach included: principal, teachers, pre-service teachers, parents and students		Typically developing	1045	7–10	Get skilled: get active	N/A	Y	School level	Only the mean % of improvement in near mastery or mastery for treatment
	Nine control schools								N/A		
Chatzipanteli and colleagues (2007)	Music-based	N/A	8 weeks N/A min	N/A	40	6.3	TGMD-2 Object control	N/A	N/A	Not indicated	The full article is only available in the original language of publication (Greek) An English abstract is available and was used to provide information
	Movement programme, no music				35	6.3			N/A		
	No control group										
Deli and colleagues (2006)	Movement programme	Physical educator	10 weeks 700 min	Typically developing	28	5.4	TGMD Locomotor	Raw	Y Five of six skills	Not indicated	Means reported for individual skills Standard deviations not reported
	Movement programme, with music				28	5.5			Y Five of six skills		
	Control group	Regularly scheduled free play			27	5.4			N		
Deri and colleagues (2001)	Music-based	Researchers	10 weeks 800 min	Typically developing	35	5.4	TGMD Locomotor	Raw	Y	Individual level	Means and standard deviations reported for individual skills only
	Control	Regularly scheduled free play		Typically developing	33	5.4	Locomotor		Y		
Foweather and colleagues (2008)	Activity-based After-school setting	Coaches	9 weeks 1080 min	Typically developing	19	9.2	Get skilled: get active	N/A	Y Two of seven skills	School/class level	Only the mean % of participants at pre- and post-intervention that demonstrated near mastery or mastery of each individual skill was provided
	Control	Regularly scheduled free play			15	9.1					
Goodway & Amui (2007)	Mastery	Researchers	9 weeks 540 min	Disadvantaged	24	Pre-school	TGMD-2 Object control	Raw	Y	Individual	Conference abstract
	Direct instruction				27				Y		
	Control				26				N		

Ignico and colleagues (2006)	Fitness infusion	Physical education teacher	24 weeks 1440 min	Typically developing	68	5th grade	Tennis, gymnastics, hockey, basketball and softball skills	Raw	Y Five of six skills	N	Means reported for individual skills only, standard deviations not reported
	Typical physical education				18				Y Five of six skills		
Logan and colleagues (2011b)	Child-facilitated	Undergraduate students	12 weeks 720 min	Typically developing	14	4.6	TGMD-2	%			Conference abstract
							Locomotor		Y	N	
							Object control		N		
	No control group										
van der Mars & Butterfield (1987)	Modified direct instruction	Pre-service teachers	8 weeks 320 min	Typically developing	15	4.6	OSU SIGMA	Raw	Y Five of 10 skills	N	Conference paper
	Control				9	5.5			N		Means reported for individual skills only, standard deviations not reported
Rimmer & Kelly (1989)	Occupational therapy programme	Occupational therapist	35 weeks 8925–11 550 min	Children with learning disabilities	8	4.5	I CAN programme	N/A	N	N	Means and standard deviations reported for individual skills only
	Adapted physical education programme	Adapted physical education teacher	35 weeks 3960 min	Children with learning disabilities	11	4.9			Y Four of five skills		
	Control	Special education teachers	Regularly scheduled free play	Children with learning disabilities	10	5.0			N		
Rudisill and colleagues (2003)	Mastery	Researchers	12 weeks 840 min	At risk of DD	13	4.0	TGMD Locomotor	Raw	Y	N	Conference abstract
	No control group										

van Beurden and colleagues (2003) included balance, vertical jump, sprint run, kick, catch, throw, hop and side gallop. Foweather and colleagues (2008) included balance, leap, vertical jump, sprint run, kick, catch and throw. OSU SIGMA, Ohio State University Scale of Intra-Gross Motor Assessment (skills include: walking, stair and ladder climbing, running, throwing, catching, kicking, jumping, hopping, skipping and striking.
N/A, not applicable; TGMD, Test of Gross Motor Development.

FMS competence does not develop naturally. FMS need to be taught, practised, and reinforced through developmentally appropriate movement programmes.

A non-significant relationship was found between effect size of pre- to post-improvement of FMS and the duration of the intervention (in minutes). This is an unexpected finding because it seems intuitive that greater total intervention time would lead to a larger increase in FMS competence. However, the evidence does not support this. We offer possible explanations. It is possible that children plateau in their FMS competence after some critical amount of instruction, but due to the small number of studies that satisfied the inclusion criteria, this critical point could not be identified. The activities provided during motor skill interventions may become monotonous and lead to children disengaging over time. Most studies did not report instruction time but rather an overall time of each session. During an intervention session, there is typically time devoted to the demonstration of each task, a review of the rules, and a warm-up and cool-down period. For example, Robinson and Goodway (2009) report that each intervention session lasted 30 min, but because of management tasks, 24 min of motor skill instruction was provided. Due to the reported methods of most studies, we were unable to delineate total session and instruction time. It is possible that a relationship between intervention time and improvement in FMS would exist if actual instruction time was reported and used as a moderator variable.

$$d = \frac{\overline{\text{Pre}} - \overline{\text{Post}}}{s}$$

$$s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2}}$$

Figure 1. Cohen's d formula. d = Cohen's d; Pre = mean pre-assessment on the Test of Gross Motor Development (TGMD); Post = mean post-assessment on the TGMD; s = pooled standard deviation.

The findings of the meta-analysis provide support for the effectiveness of motor skill interventions to improve FMS in young children. The importance of physical development is emphasized by the National Association for the Education of Young Children's standards for accreditation of early childhood education centres. Research suggests that FMS competence during childhood tracks, at least somewhat, to adolescence (Branta *et al.* 1984; McKenzie *et al.* 2002). FMS development has also been associated with health-related outcomes such as higher participation in physical activity (Okely *et al.* 2001a; Robinson *et al.* 2011), higher cardiorespiratory fitness (Okely *et al.* 2001b) and a healthy body weight (Graf *et al.* 2004; Logan & Getchell 2010). Given the benefits of the development of FMS and the large number of children enrolled in early childhood settings, these setting are ideal for the implementation of motor skill interventions.

There are many obstacles that early childhood centres may encounter if a priority is placed on the development of FMS. First, young children need equipment that is developmentally appropriate for their age and body size. Second, a sufficient play space is required for movement activities. All centres do not have an indoor gymnasium, outside play area or even adequate classroom space to adapt to an intervention setting. Third, early childhood educators may not be knowledgeable with regard to how to design and implement instructionally appropriate

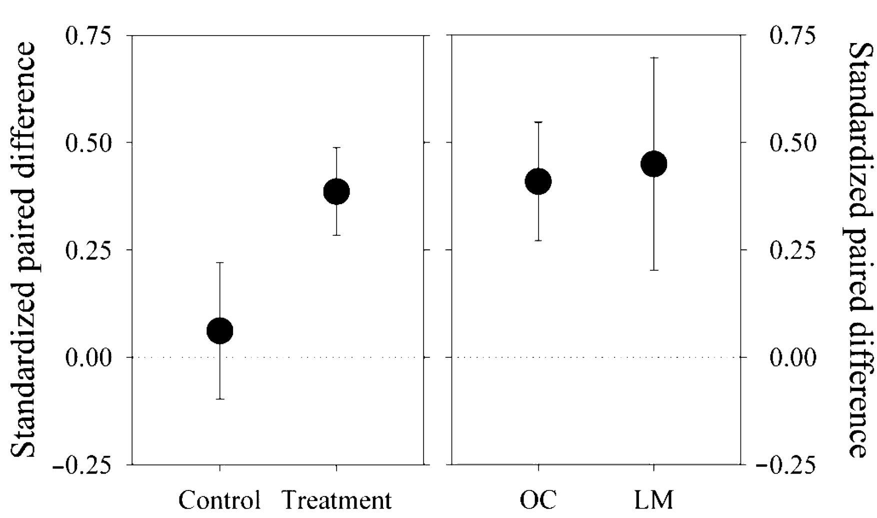

Figure 2. Mean Cohen's d and 95% confidence intervals for each meta-analysis. LM, locomotor subscale; OC, object control.

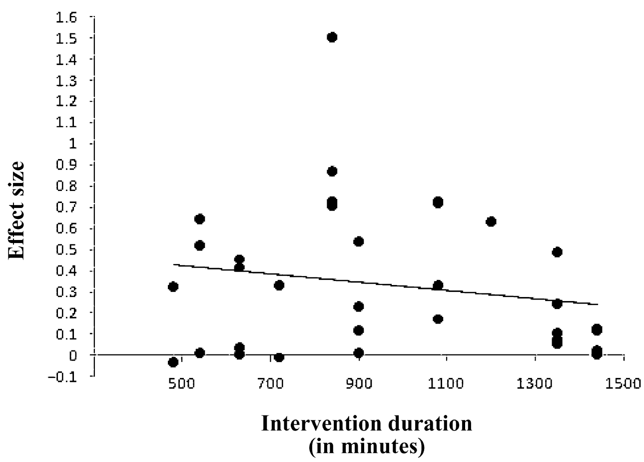

Figure 3. Pearson correlation indicating a non-significant ($P = 0.296$) relationship ($r = -0.18$) between effect size and duration of the intervention (in minutes). Only treatment groups from studies included in the meta-analyses were used to calculate this correlation.

movement activities. Early childhood educators are certainly capable of this task; however, training sessions and workshops can be expensive. Despite the obstacles, there are resources available to centres including intervention curriculum (Robert 2001) and practitioner articles that provide effective tips and guidelines for establishing ongoing motor skill interventions and movement programmes (Valentini *et al.* 1999; Robert & Yongue 2004).

There are a few limitations of the findings of this meta-analysis. Most studies included children that were developmentally delayed or at risk of delay in FMS competence due to environmental and biological factors. Therefore, the children were at risk of low FMS competence pre-assessment and had greater potential to increase FMS competence, which may have inflated effect sizes. This could also be considered a strength of this study because the results indicate that at-risk children greatly benefit from participation in a motor skill intervention. Most studies included in the meta-analysis focused only on young children and were the product of a relatively small group of researchers. Another limitation is the narrow focus with regard to the administration of a qualitative assessment of FMS as an inclusion criterion. A recent debate in the literature has questioned the interchangeable use of motor assessments that use different approaches (i.e. qualitative vs. quantitative) to measure motor competence, without regard to the specific research question of interest (Tan *et al.* 2001; Waelvelde *et al.* 2007; Stodden *et al.* 2008). These limitations are a reflection of the lack of published studies that have implemented motor skill interventions. Due to the small sample size of included studies, results should be interpreted with caution.

The findings of this meta-analysis support the need for future research to investigate the effectiveness of motor skill interventions in children. Interventions should be provided to more diverse and typically developing children who are not classified as at risk of developmental delay in FMS competence. It may be that journals are hesitant to publish intervention studies with typically developing children because of the seemingly lack of contribution to the body of literature. However, it is important that researchers continue to manipulate the components of interventions such as type of approach and amount of instruction time to determine the optimal characteristics of effective interventions. Such characteristics include the length of the intervention, the type of instructional approach and the content of curriculum. Researchers are encouraged to report means and standard deviations for all intervention studies. There were quite a few studies that were not included in our meta-analyses due to not reporting required data. More research is needed on the feasibility of early childhood educators to successfully implement motor skill interventions. Early childhood education centres serve many children in the USA on a yearly basis. These centres are an excellent environment to facilitate physical development through the implementation of developmentally and instructionally appropriate motor skill interventions.

Key messages

- The National Association for the Education of Young Children emphasizes the importance of the physical development of children. One aspect of physical development is the learning of fundamental movement skills.
- Fundamental movement skills are associated with positive, health-related outcomes.
- Results of the meta-analysis indicate that motor skill interventions are effective in improving fundamental movement skills in children.
- Early childhood education centres should implement 'planned' gross movement programmes as a strategy to promote physical development of children.
- From a research standpoint, it is important to continue to determine the most effective characteristics of motor skill interventions (i.e. minutes of instruction time, instructional approaches) to shape policy and curriculum recommendations of structured movement programmes in early childhood settings.

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References marked with an asterisk indicate studies included in the meta-analysis.

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