The Gross Motor Skills of Children with Mild Learning Disabilities

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Abstract

Many international studies have examined the gross motor skills of children studying in special schools while local studies of such nature are limited. This study investigated the gross motor skills of children with Mild Learning Disabilities (MLD; n = 14, M age = 8.93 years, SD = .33) with the Test of Gross Motor Development-2 (TGMD-2, Ulrich, 2000). The TGMD-2 consists of 12 items equally divided into two subtests (locomotor & object control). The locomotor subtest includes run, gallop, hop, leap, horizontal jump and slide while the object control subtest includes strike a stationary ball, stationary dribble, kick, catch, overhand throw and underhand roll. The results revealed significant differences in 8 out of 12 test items: gallop, hop, leap, horizontal jump, slide, strike, dribble and roll at mastery level between children with MLD and TGMD-2 norm population. The authors suggest motor interventions for children with MLD to improve their gross motor skills.

Keywords:

mild learning disabilities; motor skills; TGMD-2; children; motor intervention, special needs

Introduction

Background of Special Education in Singapore

In Singapore, about three percent of the annual births requires early intervention services where the Child Development Unit (CDU) at Kandang Kerbau Women's and Children's Hospital (KKH) and National University Hospital (NUH) receive most of the referrals of between 1200 and 1400 annually (Ho, 2007). Children with Mild Learning Disabilities (MLD) could be amongst these children with special needs who receive early intervention services. When these children with MLD in Singapore grow up, majority of them study in special schools although some could be included in regular schools. To ensure better integration or inclusion of these children with MLD, the Ministry of Education (MOE) has provided various strategies and policies including the employment and training of Allied Educators (AEDs). Given this support, the possibility of including more children with MLD in regular education becomes a reality. Hence, as more children with MLD integrate into regular classrooms, the understanding of their motor performance becomes increasingly necessary.

Internationally, researchers have recognised the close relationships between cognitive, physical and motor development (Bjorklund & Brown, 1998; Diamond, 2000). Local researchers have also advocated and supported that child development should be viewed from a holistic approach and explored into the domains of cognitive, social and emotional and the physical (Chia, 2009). The motor skills of children with MLD as the focus of this proposal, is classified under the physical domain of child development. Drawing from the number of infants born with these disabilities and the potential of those who can be included in regular classrooms, an understanding of their motor skills and how this affects their performance in gross motor tasks is warranted.

Presently, the motor abilities and physical fitness of children with MLD in Singapore are not known to be documented. Further, whether there are motor intervention programmes and/or movement programmes for these children with MLD in Singapore remains unclear too. Therefore, the understanding of the effect of motor intervention programme on the motor performance of children with MLD will add on to the existing body of knowledge both locally and internationally.

The 'No Child Left Behind Act' of 2001 (No Child Left Behind [NCLB], 2002) has triggered worldwide attention for Special Education. More recently, the issue of including children with special needs into Singapore mainstream schools has received tremendous focus which is a shift towards making provisions for special educational needs in Singapore (Nonis, 2006; Teo, 2004). In 2005, Singapore has too, emphasised the NCLB (2002) policy, and launched the ComCare Fund[1] to ensure "no Singaporean is left behind". The ComCare Fund in Singapore aims to help every child grow and develop. Hence, this study aligns with the ComCare Fund by providing information of the motor performance of the children with MLD in the physical domain.

Since children with MLD included in regular education would also be included in regular Physical Education (PE) lessons and for them to enjoy PE lessons together with their typically developing peers, there is a need to ensure effective opportunities to develop their gross motor skills in planning for physical fitness programmes and PE lessons. It is then more important to plan suitable motor intervention programmes and/or physical activities for children with MLD to overcome their difficulties in sporting activities. In this way, children with MLD can achieve developmentally appropriate motor performance which is necessary to complement successful integration in Singapore.

[1] ComCare Fund provides a safety net for needy Singaporeans with disabilities which will advocate the aim to provide every child the opportunity to grow and develop (Ministry of Social and Family Development, 2005).

The Gross Motor Skills of Children with Typical Development

The Test of Gross Motor Development-2 (TGMD-2, Ulrich, 2000) has been used extensively to assess the motor performance of children with typical development. Internationally, Pollatou, Konstantina and Karadimou (2005) assessed the gross motor skills performance of 95 preschool children (50 girls, 45 boys; *M* Age = 5.4 years old) and revealed no gender difference.

Sanders and Kidman (1998) investigated elementary school children (*n* = 225, 123 girls, 102 boys, *M* age = 10 years old) and reported none of the 225 children had mastery level (matured form) in all 12 test items of the TGMD-2 (Ulrich, 2000). Less than 50% of the girls had attained mastery in nine out of 12 test items. These include strike (6.5%), bounce (46.3%), kick (1.6%), overarm throw (6.5%), gallop (18.7%), hop (46.3%), leap (49.6%), jump (17.9%) and skip (46.3%). The three most developed test items attaining mastery by the girls were slide (94.3%), catch (80.5%) and run (72.3%). For the boys, less than 50% had attained mastery in six out of 12 test items. These include strike (39.2%), kick (12.7%), overarm throw (40.2%), gallop (18.6%), jump (12.7%) and skip (43.1%). The three most developed test items with mastery by the boys were slide (89.2%), bounce (76.5%), catch (74.5%) and run (73.5%). However, 82.2% of children were either classified as poor or very poor in overall FMS where only two boys had attained mastery for five object control skills and only two girls had attained mastery for seven locomotor skills. None of the boys attained mastery for all locomotor skills and none of the girls attained mastery for all object control skills. Significant gender difference found in object control and locomotor skills where the boys excel in both areas as compared to the girls. The poor FMS performance of these elementary school children could pose several problems for PE teachers in later years (Sanders & Kidman, 1998). Sanders and Kidman (1998) highlighted the consideration of

developing FMS in physical activity programmes and revising training practices during the children's involvement in community sporting clubs.

Choi Tse (2004) conducted a preliminary study on the gross motor performance of Hong Kong Chinese children (*n* = 90, 45 boys, 45 girls, age range: 6 – 8 years old) using TGMD-2 (Ulrich, 2000). Only 1.1% (*n* = 1) and 27.6% of the children achieved above-average (above 75th percentile) and average (within 25th – 75th percentile) level of performance respectively. The majority of the children performed below TGMD-2 norm with 27.6% and 40% of them attaining below-average (within 10th – 25th percentile) and poor (below 10th percentile) level of performance respectively (Choi Tse, 2004). No significant gender difference was found. But age differences were found in "dribble" and "overhand throw". Nearly 50% of the children achieved mastery in the slide (*n* = 59), run (*n* = 45) and dribble (*n* = 41) skills. The most under-developed skills exhibited through least number of children achieving mastery were the hop (*n* = 2), catch (*n* = 10) and underhand roll (*n* = 10) skills. Choi Tse (2004) suggested skills with poor mastery would need more attention during PE lessons. Seven skills which needed more attention were gallop, hop, leap, jump, catch, kick and overhead throw. Choi Tse (2004) recommended the use of TGMD-2 to assess the quality of gross motor skills of children would help identify the matured skills and the problems of motor behaviours for better teaching strategies and PE activities.

Wong and Cheung (2006) evaluated the gross motor performance of Hong Kong Chinese children (*n* = 1251, 692 boys, 559 girls, age range: 3 – 10 years old) and reported gradual increase over age was shown in terms of raw scores for both boys and girls in both locomotor and object control subtests. Among the 12 test items, the locomotor and object-control skills with the highest mastery levels were run (67.8%) and kick (37.1%) respectively. The most underdeveloped locomotor and object-control skills were hop (5.3%) and overhead throw (5.4%) respectively. In reference to the children at eight (*n* = 89) and nine years old (*n*

= 108), the percentage of their skill mastery for the 12 test items were hop (9.0% & 12.0%), slide (74.2% & 67.6%), gallop (77.5% & 74.1%), jump (78.7% & 80.6%), leap (42.7% & 72.2%), run (96.6% & 88.9%), dribble (46.1% & 47.2%), kick (36.0% & 59.3%), catch (18.0% & 10.2%), throw (13.5% & 7.4%), roll (3.4% & 14.8%) and strike (37.1% & 38.9%). Overall, the mastery level of gross motor skills improved with age. Wong and Cheung (2006) concluded that the performance of their object control skills was poorer than the norm TGMD-2 data of same age and gender but not for locomotor skills. Wong and Cheung's (2006) findings highlight the need for more instructional programmes designed for object control skills.

The Gross Motor Skills of Children with Special Needs

The TGMD-2 (Ulrich, 2000) was also used to assess children with special needs (Lieberman, Volding & Winnick, 2004; Simons et al., 2008). Simons et al. (2008) have evaluated the validity and reliability of the TGMD-2 Ulrich, 2000) on Flemish children with mild intellectual disability (n = 99; age range: 7 – 10 years old, 67 boys & 32 girls; Total Intelligence Quotient [TIQ]: 52 – 70) and reported the TGMD-2 tool as a reliable instrument for assessing children with mild intellectual disability. In Simons et al.'s (2008) study, the Gross Motor Quotient (GMQ) of the Flemish children was performing significantly poorer than the TGMD-2 norm population ($p < .001$). Specifically, the Flemish children scored a lower GMQ (M = 76.67, SD = 13.46) of which the descriptive ratings according to TGMD-2 (Ulrich, 2000) indicated that these Flemish children were performing at a "poor" level for the 12 test items. By comparison, the GMQ of the TGMD-2 norm population (n = 1208) was higher and at an "average" level (M = 100, SD = 15). In addition, the authors reported a low significant age effect for the object control skills only (Simons et al., 2008). Furthermore, a

significant poorer performance in the Flemish children was observed when their results were compared with the TGMD norm population (Simons et al., 2008).

Lieberman et al. (2004) investigated 29 children with HI (n = 27; 11 girls, 18 boys, M age = 6 years, age range: 4 – 9 years) using the TGMD (Ulrich, 1985). Lieberman et al. (2004) compared the motor development of children with HI who have non-hearing parents (n = 14) with those who have hearing parents (n = 15). The results revealed age as a significant factor for both locomotor and object control skills. In general, a higher percentage of children with HI had either reached or surpassed average performance levels in object control skills compared with locomotor skills.

Studies involving motor intervention programmes have shown that children with poor motor skills improve post intervention (Larkin & Parker, 2002; Revie & Larkin, 1993; Valentini & Rudisill, 2004). Revie and Larkin (1993) implemented a task-specific intervention (60-minute x 8 weeks) on children identified as poorly coordinated (n = 21, age range: 5 – 9 years) in an attempt to improve their motor skills commonly used for daily physical activities. Selected motor skills were distance throw, target kicking, volleyball bouncing-and-catching as well as distance hopping. With the exception of distance hop, pre- and post-test results using TGMD (Ulrich, 1985) revealed significant improvements in all motor tasks ($p < .05$). The authors concluded that intensive task-specific training (with specific instructions, guidance & feedback) was useful to teach children with motor learning difficulties who usually had problems in balance and coordination (Revie & Larkin, 1993).

Valentini and Rudisill (2004) also examined how students (Age range: 5.9 – 10.9 years) with and without disabilities benefit from an inclusive mastery climate intervention. In Valentini and Rudisill's (2004) study, a mastery climate focuses on the child in which the teacher is the facilitator. In their study, participants were randomly distributed into intervention (19 participants with disabilities & 31 participants without disabilities) and

comparison groups (17 participants with disabilities & 37 without disabilities). Participants performed the TGMD-2 (Ulrich, 2000) before and after the intervention. The results showed that children with and without disabilities who received 12 weeks of intervention demonstrated significant improvement in motor skill performance from pre- to post-intervention. However, the control group who did not receive intervention did not show any significant improvement in motor skill performance. These findings suggest that the mastery climate intervention provided similar learning opportunities for children with and without disabilities (Valentini & Rudisill, 2004).

This study aimed to understand the gross motor skills of children with MLD and examine the differences in their motor performance as compared with the TGMD-2 norm population (Ulrich, 2000). This study is then be useful to stakeholders (i.e. Schools, Teachers, Educators, Counsellors, Therapists, Parents, Caregivers) in the field of mainstream and special needs education as the data collected will also provide insights to the motor abilities of children with MLD in special schools in Singapore.

Method

Participants

A total of 14 children with MLD (n = 14, M age = 8.93 years, SD = .33; see Table 1) participated in the study. MLD is defined as having the Intelligence Quotient of less than 70 (IQ < 70). Informed and voluntary consents from parents and school to conduct research were obtained. Ethics clearance was obtained from Institutional Review Board (IRB) of Nanyang Technological University (NTU).

Table 1

Age and Gender of Children with MLD (n =14)

Gender	*n*	Min.	Max.	*M*	*SD*
Male	10	8.50	9.50	8.90	0.00
Female	4	9.00	9.00	9.00	0.39
All	14	8.50	9.50	8.93	0.32

Instrument

The TGMD-2 (Ulrich, 2000) was used to investigate the motor performance of children in this study. The TGMD-2 examines the gross motor development of children from age 3 years, 0 months to 10 years, 11 months (Ulrich, 2000). The TGMD-2 consists of 12 test items equally divided into two subtests (6 locomotor test items & 6 object control test items). The locomotor subtest includes run, gallop, hop, leap, horizontal jump and slide while the object control subtest includes strike a stationary ball, stationary dribble, kick, catch, overhand throw and underhand roll. The TGMD-2 instrument was selected for its reliability (large normative sample), suitability (same age group and gender ratio) and short assessment duration (20 minutes per subtest, Ulrich 2000). Each test item includes four to five performance criteria to describe the performance qualitatively.

Procedures

This study was conducted in school during the PE lessons of the participants. Prior to testing and data collection, rapport building with the participants, logistics preparation of the test venue and equipment set-up according to TGMD-2 requirements were carried out to allow familiarization and to reduce any possible anxiety amongst the children. Each child was tested individually in appropriate sportswear with covered shoes. Rest periods were provided between trials for all tasks.

Standardized verbal instructions were used for each motor skill of the test items. The tester demonstrated every skill to each participant twice before each trial. The participants were then given the chance to perform each skill twice in a sequence of run, gallop, hop, leap, horizontal jump and slide. The tester observed the performance of each participant and awarded a score of '1' when the participant performed the test items according to the performance criteria of the skill. A score of '0'was awarded when the participants did not meet the performance criteria of the skill. The duration of each subtest took no more than 20 minutes.

Data Analysis

The raw scores computed from the test protocols of the TGMD-2 motor tasks were summed as per task and converted into standard score, percentile, age equivalents and GMQ according to the age appropriate norm tables provided in the TGMD-2 manual (Ulrich, 2000). Individual standard score of each TGMD-2 gross motor task of the participants were used for further statistical analysis. Data were calculated and analysed using the Statistical Package for Social Science (SPSS version 16.0®). The tests used were Mann-Whitney test, Kruskal-Wallis test and one-sample binominal test. The level of statistical significance was set at $p \leq .05$.

Result & Discussion

Age Equivalent & Chronological Age

The results showed that the children with MLD were performing below-norm for both object control and locomotor skills when compared with the age equivalents of the TGMD-2

normative sample (see Table 2). While the mean chronological age of all children with MLD was 8.93 years, both their object control and locomotor skills showed that they were performing at an age equivalent of 4.86 and 4.09 years respectively (see Table 2). The descriptive ratings indicated that these children with MLD were also performing at "very poor" level for the 12 test items (see Table 2). As the results further showed insignificant age and gender differences within the participants using the Mann-Whitney and Kruskal-Wallis tests ($p > .05$), this would suggest that the children with MLD in this study, exhibited motor proficiency which were below their chronological age. Poor overall motor performance has also been reported in another study (Simons et al., 2008). The findings of this study suggest that poor motor performance with an intervention programme as reported in other studies (Revie & Larkin, 1993; Valentini & Rudisill, 2004) could be useful to improve the motor performance of children with MLD.

Table 2

Comparison of TGMD-2 performance using age equivalent and chronological age

	M age equivalent						
N	Object control subtest	locomotor subtest	*M* Age	Standard Score	GMQ	Percentile	Descriptive ratings
14	4.86	4.09	8.93	7.14	61.3	<1	very poor

Skill Mastery

The percentages of master level of both children with MLD and the TGMD-2 norm population were compared using the one-sample binominal test. The results showed significant differences between children with MLD and the TGMD-2 norm population in terms of mastery level for Gallop, Hop on preferred leg (Hop P), Hop on non-preferred leg (Hop NP), Leap, Jump, Slide, Strike, Dribble and Roll ($p < .05$; see Table 3). Specifically, the

results indicate that the mastery level of the children with MLD was significantly lower in five out of six locomotor test items as compared with the TGMD-2 norm population ($p < .05$; see Table 3). However, the mastery level of the children with MLD was significantly lower in three out of six object-control test items ($p < .05$; see Table 3). This finding suggest that in developing a motor intervention programme for children with MLD, the skills of Gallop, Hop, Leap, Jump, Slide, Strike, Dribble and Roll should be taken into consideration.

Table 3

Comparison of mastery performance between Children with MLD & TGMD-2 norm population

Locomotor Test Items	% of mastery			Object-Control Test Items	% of mastery		
	MLD	TGMD-2	*p*		MLD	TGMD-2	*p*
Gallop	20.00	45.00	.006	Strike	0.00	53.00	.000
Hop P	0.00	48.00	.000	Dribble	21.43	28.00	.000
Hop NP	0.00	48.00	.000	Roll	14.29	60.00	.040
Leap	0.00	52.00	.000				
Jump	6.67	56.00	.002				
Slide	53.33	19.00	.014				

Conclusion

Gross motor skills play an important role in developing the child holistically. Children with typical development would attain an acceptable level of motor proficiency by the age of nine years to participate in physical play. Overall, studies have shown that children with disabilities tend to have poorer motor skills as compared with children with typical development (Revie & Larkin, 1993; Simons et al., 2008). The findings of this study indicated that children with MLD were lagging behind their age-matched peers by

approximately four years in terms of TGMD-2 test items. The skill mastery of children with MLD was significantly poorer for eight out of 12 TGMD-2 test items especially locomotor skills. The authors recommend a motor intervention programme which includes a deliberate plan to improve the skills of Gallop, Hop, Leap, Jump, Slide, Strike, Dribble and Roll.

References

Bjorklund, D. F. & Brown, R. D. (1998). Physical play and cognitive development: Integrating activity, cognitive, and education. *Child Development, 69*(3), 604-606.

Chia, M. (2009). Play reconsidered, resurrected and repositioned in children: Case study results from Singapore. *Sport Science, 2*(1), 44-48.

Choi Tse, K. (2004). A preliminary study on gross motor performance of Hong Kong children aged 6-8 years. *Journal of Physical Education & Recreation (Hong Kong), 10*(2), 67-72.

Diamond, A. (2000). Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child Development, 71*(1), 44-56.

Ho., L. Y. (2007). Child development programme in Singapore 1988 to 2007. *Annals Academy of Medicine Singapore, 36*(11), 898-910.

Larkin, D. & Parker, H. (2002) Task-specific intervention for children with developmental coordination disorder: A systems view. In S. A. Cermak, & D. Larkin (Eds.), *Developmental Coordination Disorder* (pp. 235–247). Albany, NY: Thompson Learning.

Lieberman, L. J., Volding, L., & Winnick, J. P. (2004). Comparing motor development of deaf children of deaf parents and deaf children of hearing parents. *American Annals of the Deaf, 149*(3), 281-289.

Ministry of Social and Family Development. (2005, June). *Prime Minister launches the ComCare Fund.* Retrieved from http://www.msf.gov.sg/web/Faces/Faces41/index.html

Nonis, K. P. (2006). Integrating children with special needs: Singapore preschool teachers share their feelings: A preliminary investigation. *The Journal of the International Association of Special Education, Spring, 7*(1), 4 -10.

Pollatou, E., Karadimou, K., & Gerodimos, V. (2005). Gender differences in musical aptitude, rhythmic ability and motor performance in preschool children. *Early Child Development and Care, 175*(4), 361-369.

Revie, G., & Larkin, D. (1993). Task-specific intervention with children reduces movement problems. *Adapted Physical Activity Quarterly, 10,* 29-41.

Sanders, L., & Kidman, L. (1998). Can primary school children perform fundamental motor skills? *Journal of Physical Education New Zealand, 31*(4), 11-13.

Simons, J., Daly, D., Theodorou, F., Caron, C., Simons, J., & Andoniadou, E. (2007). Validity and reliability of the TGMD-2 in 7-10-year-old flemish children with intellectual disability. *Adapted Physical Activity Quarterly, 25,* 71-82.

Teo, L. (2004, 19 September). $220 school aid for disabled kids. *The Sunday Times,* p. 8.

Valentini, N. C., & Rudisill, M. E. (2004). An inclusive mastery climate intervention and the motor skill development of children with and without Disabilities. *Adapted Physical Activity Quarterly, 21,* 330-347.

Wong, A., & Cheung, S. Y. (2006). Gross motor skills performance of Hong Kong Chinese children. *Journal of Physical Education & Recreation (Hong Kong), 12*(2), 23-29.

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