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Research article

MOTOR SKILL DEVELOPMENT OF PRE-SCHOOL CHILDREN AT NATIONAL CHILD DEVELOPMENT RESEARCH CENTER, UNIVERSITI PENDIDIKAN SULTAN IDRIS

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Abstract
Journal of Sports Science and Physical Education 3(1): 87–94, 2015 - The development of motor skills is fundamental to the continued movement and specific skills in the sport. The development of motor skills concurrent with their age allows them to acquire and master locomotor and object control skills through physical activity. This study aims to identify the gross motor developmental stage among six year old girls at the National Child Development Research Center, Universiti Pendidikan Sultan Idris. This study focuses on the level of gross motor development and the relationship between Gross Motor Quotient (GMQ and Body Mass Index (BMI) of the children. Gross motor development data was obtained using the Test of Gross Motor Development, Second Edition (TGMD-2). BMI data was determined from existing formula. The gross motor development of the children in this study was 95%. This is based on the percentile level of gross motor development (GMQ percentile). Pearson correlation analysis showed a negative relationship between GMQ and BMI for these children.

Keywords: *motor skill, pre-school children, locomotor, BMI*

Introduction

The ability to perform motor skills is necessary in children enable them succeed in activities that use large muscles. Well-developed gross movement skills help individuals to function more smoothly in their daily life and more likely to participate in recreational and exercise or sport specific activities during their adult years. Children who are able to master their fundamental movement skills will engage in play and other physical activities when such opportunities are offered or present (Gallahue, 2003). A child who is habitually active physically will likely grow up grow to be an active adult (Little & Yorke 2003). Since physical inactivity is associated with cardiovascular disease, thromboembolic stroke, hypertension, type II diabetes, osteoporosis, obesity, colon cancer, breast cancer, anxiety and depression (Kesaniemi, et al., 2003) teaching children motor skills and mastering them through play and exploration will encourage them to adopt healthy and physically active lifestyles that may carry over into adult life.

Most children between the ages of 2 to 6 years old acquire a basic range of manipulative and locomotor skills, develop goal-directed motor behaviours, and learn to put together two or three movement

sequences to accomplish specific end goals old (Bruininks, 1978; Piaget 1963; Sporns & Edelmam 1993). A delay in the development of age appropriate gross motor skills has been postulated to be associated with a number of potentially serious health conditions such as childhood obesity (Graf, Koch & Kretschmann-Kandel, 2004; Okely, Booth & Chey, 2004) and also lower self-perceptions on movement competence. Poor physical self-perceptions lead to reduced confidence in movement that often extends beyond the athletic domain and results in adverse psychosocial consequences (Roberts, Kleiber & Duda, 1981; Weiss, 1990; Bouchard & Tetrault, 2000).

The assessment of gross motor development in pre-school children may help parents, teachers and significant others associated with their growth and development to identify children who are significantly behind their peers in gross motor skill development. Upon enrolling in primary school, such an assessment would allow teachers to plan an instructional program in gross motor skill development, and assess individual progress in gross motor skill development for children who show delayed development in age appropriate gross motor skills.

Maturation should not be considered the sole factor contributing to motor skill development (Thelen, 2000; Ulrich, 1989) since environmental factors may also influence the fundamental movement phase of development (Gallahue, 1982). One such environment where competency in gross motor skills may be developed is the school. It has been suggested that physical education in early school intervention is the only place where children would be instructed and intervened in order to achieve proficiency in fundamental motor patterns (Gallahue & Donnelly, 2007).

Many tests are available to assess early motor development in children (Shahrial 2014) and this includes the Test of Gross Motor Development, second edition (TGMD-2) (Ulrish 2000). This test has been used in many studies to assess fundamental motor skill proficiency in typical or atypical children. The TGMD-2 was also used in this study for the purpose of examining the gross motor development of female pre-school children attending regular physical education activities at National Child Development Research Center (NCDRC), Universiti Pendidikan Sultan Idris (UPSI). The relationship between body mass index and gross motor between body mass index and gross motor development is also examined.

Methods

This research uses an exploratory design with the purpose of examining the gross motor development of female pre-school children (6 year olds) and the relationship between their body mass index (BMI) and gross motor quotient (GMQ) from TGMD-2.

Participants

Nineteen healthy pre-school girls, with a mean age of 77±2.4 months (6 years and 5 months) from NCDRC, UPSI were recruited for participation in this study. These children enrolled in physical education activities, 30-minute session ministered once a week by a non-specialist physical education classroom teacher. Consent was obtained from NCDRC's administrators to undertake this study.

Procedures

All tests and data collection for the TGMD-2 (Ulrish 2000) was conducted in the school facility at the end of the pre-school year, in November 2014.

Prior to testing, the NCDRC's pre-schoolers' height and body weight, were obtained. Upon completion of these measurements, the children were assigned a

number for identification throughout and after the test. They then performed both locomotor and object control subtest abilities as described in TGMD-2 (Ulrish 2000) literature. All performance by these children was videotaped using two cameras (Sony-Model DCR-HC96). One camera was placed in one area for the recording of all locomotor sub-test abilities and the second camera was placed nearby and used to record all the object control sub-test abilities.

A demonstration and verbal description of the skill as per TGMD-2 instructions (Ulrish 2000) were provided to the child by two experienced physical education instructor before the test, one for the locomotor subtest abilities and one for the object control abilities. Following the demonstration and description sessions, each child was given one practice trial to assure that the child understood what to do. If the child did not understand the task or had not performed the practice correctly trial, further demonstrations and instructions were provided by the same physical educators.

Each child then performed two trials for each gross motor skill. The first test was for all the locomotor subtest abilities and then followed by all the object control abilities. The tests for each child took between 15 to 20 minutes to complete.

Data Analysis

Each child performance was rated by three physical education instructors (PSI) who were trained to competently rate the gross motor skill following the performance criteria described in the TGMD-2 [17]. Prior to the test involving the NCDRC's pre-school children, a competency rating test was conducted for the PSI involving a group of pre-schoolers from other another pre-school. A post-test discussion was conducted amongst the PSI for any discordance in ratings. Assessment for the actual pre-school children in this study was only carried out after all the PSI showed concordance above 85% in the competency test.

The PSI used the videotaped performance of each gross motor skill for their assessment. They were allowed to review the recorded images as many times as necessary in their assessment of each gross motor skill using the performance criteria. A value of 1 or 0 was assigned to the specific performance criteria if the behavioral component was observed or absent, respectively.

Scores for the two trials were added together to get the total score for each performance criteria. The skill score was determined by adding together the total scores for each criterion. The six skill scores obtained at the end of each subtest (locomotor and object control) were added up to get the subtest raw score. Finally the subtest standard totals were converted to the Gross Motor Quotient (GMO) and percentile. The Gross Motor Quotient is the most useful value obtained from the TGMD-2 because it reflects the basic constructs built into the test, is highly reliable and is a composite of both subtests. It is the best estimate of an individual's current gross motor development. High scores indicate well developed locomotor and object control skills. Low scores indicate weak locomotor and object control skills.

Based on the raw score, motor age-equivalent was obtained which indicates the developmental level or age that corresponds to the raw score obtained by the children. Motor age-equivalent was obtained for each child in both locomotor and object control subtest, following normative data (Ulrish, 2000).

Statistical analysis

Data analysis included descriptive analysis and Pearson correlation. Mean and standard

deviation were calculated for all variables and presented as mean±SD. Result for the correlation analysis was considered significant at level of $p<0.05$

Results

Anthropometric data

The chronological age, height, body weight and BMI of the pre-school children in study are depicted in Table 1.

Table 1: Mean and standard deviation of chronological age, height, body weight and BMI of female pre-school children at NCDRC UPSI

Age (years)	Height (m)	Body weight (kg)	BMI ($kg \cdot m^2$)
6.4±0.2	1.15± 0.1	20.3± 2.8	15.3± 1.2

Motor Skill Performance

The locomotor subtest raw score for the pre-schoolers were 38.2±2.9. The equivalent motor age for their locomotor performance as provided for in the TGMD-2 manual (Ulrish, 2000) is 6-3 or 6 years and 3 months. For the object control subtest raw score, their performance in the object control test was 32.2±2.5 and this put them at an equivalent motor age of 6-6 or 6 year s and 6 months.

The Gross Motor Quotient (GMO) for these children was 101.6 (4.8) and it put them at the 25-75th percentile.

Table 2: Equivalent motor age associated with locomotor and motor control subtest raw scores of female pre-schooler children at NCDRC UPSI

Perfomance	Score	Equivalent motor age
Locomotor	38.2±2.9	6-3
Object control	32.2 ±2.5	6-6

Chronological and Motor Age Comparison

The chronological age of the pre-schoolers in this study was 6-4 or 6 years and 4 months old. Based on the subtest scores for their locomotor performance it revealed that they were one month below their chronological age in terms of this performance. Their locomotor performance was equivalent to those age 6-3 or 6 years and 3 months old children. In motor control, their subtest scores were equivalent to those of 6-6 or 6 ½ years old even though their chronological age was 6-4 or 6 years and 4 months.

Correlation between Locomotor Performance and BMI

Analysis using Pearson Correlation showed no significant correlation between the pre-schooler's BMI that and locomotor performance, $r=0.03$; $p=0.92$.

Discussion

This study examined the gross motor development of children attending NCDRC, UPSI and had regular physical education, provided by a classroom teacher which had no formal Physical Education training. Our results showed that the female pre-schoolers children were slightly delayed in their locomotor development when compared to equivalent motor age. However for object control, they were more advance with regard to their chronological age. Their performance was on par with the performances of 6 ½ years old children. When the two scores for both subtests were added together to determine their GMO and percentile, our results showed their motor development was at the average level for their chronological age. Their current motor development status also puts them in the 25th to 75th percentile.

In this study, the pre-schoolers showed slightly delayed locomotor development when compared to the equivalent motor age.

When compared with a similar study done in Hong Kong (Chow & Chan, 2011) and Sumatera, Indonesia (Syahrial, 2014), the pre-schoolers at NCDRC, UPSI fared better than their counterparts in the aforementioned countries where the sub-scores for locomotor performance was 33.2±6.2 and 35.9±8.2 respectively. The slight delay in motor performance development compared to what is expected of their chronological age might be attributed to anecdotal observations that revealed the pre-schoolers in this study had limited access to outside play due to the lack of playground equipment in the NCDRC compound and outside of school and also to risky nature of their community open grounds and parks. We propose that the environments in which these children are growing up constrained the development of fundamental motor skills. Apart from this, the instruction they received during their physical education sessions might not be quite sufficient to promote better development of their locomotor skills due to the lack of expertise in teachers teaching them.

Fundamental motor skills do not develop as a result of age but they must be instructed and practiced (Haywood & Getchell, 2002; Payne & Isaacs, 2002). This is in line with the dynamic systems theoretical perspective which proposed that fundamental motor skills do not naturally happen or appear during early childhood but they are the result of many cooperating subsystems influencing a child's motor skill development (Newell, 1986; Thelen, 1995; Brauner & Valentini, 2009) .

In object control, as opposed to the findings in an earlier research (Brauner & Valentini, 2009), this group of pre-schoolers not only showed no delay in this aspect, their performance was also more advanced than their peers in that it was equivalent to children aged 6½ years old. This performance which is reflected by a score of 32.2±2.5 was much better than similar age girls from Hong Kong (Chow & Chan, 2011) whom scored 28.8 ±7.6. However the NCDRC's pre-schoolers performances were lower than those from Sumatera, Indonesia (Syahrial 2014) whom scored 35.6±6.3. A possible explanation for this is that between the ages of 5 and 6 years old, these children might not have suffered a notable lack of experience in performing manipulative tasks. Such a suggestion might be corroborated by the same anecdotal observation that young girls spend more time in their homes as opposed to the outside in the dominantly sub-urban Malay population from which these pre-school children come from. In the rural and sub-urban Malay community, girls especially for the younger ages are more often than not spending more time within the confines of their homes. In such an environment, lack of space and peer group socialization would have allowed them to focus on manipulation of objects or object control involving dolls, or other household items during play time or helping around the house doing household chores.

Gross motor quotient scores for the group of preschool children involved in this study also showed average gross motor development. Delayed performance in gross motor development observed in previous studies (Brauner & Valentini, 2009; Braga, Krebs, Valentini & Tkac, 2009) might lead to drastic consequences in skill acquisition in subsequent years. Children who are at risk of developmental delay have been found to demonstrate developmental delays in fundamental motor skill development (Connor-Kuntz & Dummer 1996; Goodway & Rudisill, 1997; Hamilton, Goodway & Haubenstricker, 1999). Intervention programs to improve motor skill performance in children have already been demonstrated in previous studies (Brauner &

Valentini, 2009; Braga, Krebs, Valentini & Tkac, 2009; Lopes & Preira, 2004). However, such improvements are due to specific intervention programs such as the physical education program in the regular school curriculum (Lemos, Avigi & Barela, 2012). This is important since children may master gross motor skills and achieve better developmental levels when opportunity of practice and appropriate instruction are provided at the sensitive periods (Bornstein, 1989) or ages in which they are most responsive. For the NCDRC's pre-schoolers although their gross motor development is at the average level, their current gross motor development may be further improved when they attend primary school where physical education is offered regularly and taught by specialist teachers. Assessments of gross and fine motor skills via School Based Assessments are also part and parcel of the physical education curriculum in primary schools to monitor movement competencies and to address and provide remedial action to those who show non appropriate gross motor development.

With regard to the influence of BMI on gross motor skill performance, evidence show that obese children have poorer gross motor skill performance compare to their normal weight peers were reported in few studies (Castethon & Andreveva, 2012; D'hondt et al., 2009; Mond, 2007). Their findings indicated that there is a negative association between excessive weight and gross motor development. In contrast to these findings, another study reported that gross motor skill performance of children aged between four and six years were not related to BMI (Catenaassi et al., 2007). Our study is in line with these findings since results show no significant correlation between the BMI of our group of pre-schoolers and their gross motor skill performance.

Conclusion

Results from this study showed that the development of gross motor development amongst NCDRC's pre-schoolers is at the average level. Although their object control skills are advanced for their chronological age, their locomotor performance showed slight delay in terms of development. Since studies have shown that gross motor development is influenced by daily physical activities and regular physical education, we proposed that appropriate and regular instruction is provided by physical education specialists. Further we also suggest that NCDRC, UPSI provide opportunities to their pre-schoolers to practice their locomotor and object control motor skills via playground activities in their facility.

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