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Artikel Asli/*Original Articles*

Gross Motor Skills Performance in Children with Dyslexia: A Comparison between Younger and Older Children

(Prestasi Kemahiran Motor Kasar dalam Kanak-kanak dengan Disleksia: Perbandingan di antara Kanak-kanak Muda dan Lebih Berusia)

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ABSTRACT

Children with dyslexia are commonly associated with gross motor difficulties. However, this non-literacy symptom is often overlooked as an important feature of dyslexia. Therefore, the aims of this study were to determine gross motor skills status among children with dyslexia and to compare the gross motor skills between younger and older children. A cross-sectional study was conducted on children with dyslexia from government schools and Dyslexia Association Malaysia. The participants were divided into two groups, namely younger (4 to 10 years) and older children (11 to 17 years old), and were recruited randomly. The gross motor skills were measured using the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) (subtests: Body Coordination, and, Strength and Agility) and the Movement Assessment Battery for Children, Second Edition (MABC-2) (subtest: Aiming and Catching). Standard scores and percentile rankings were used for statistical analysis. A total of 82 children with dyslexia were recruited for this study, consisted of younger (n = 57) and older groups of children (n = 25). The younger children were found to have a significantly lower performance in gross motor skills in Body Coordination (Mdn = 48, IQR = 26-63), compared to the older children, (Mdn = 54, IQR = 30-77), with a small effect size (r = -.25). There were no significant different for other findings. The older children were found to demonstrate the highest level of gross motor skills. This study may suggest the need for an early intervention program for young age children with dyslexia. Future studies that assess gross motor skills using longitudinal design are recommended to investigate the changes in gross motor performance over time.

Keywords: Assessment; body coordination; children; dyslexia; gross motor

ABSTRAK

Kanak-kanak dengan disleksia adalah selalu dikaitkan dengan kesukaran motor kasar. Walau bagaimanapun, simptom bukan literasi ini sering terlepas pandang sebagai salah satu ciri penting bagi disleksia. Oleh itu, tujuan kajian ini adalah untuk menentukan status kemahiran motor kasar dalam kalangan kanak-kanak dengan disleksia di antara kanak-kanak yang lebih muda dan lebih tua. Suatu kajian keratan rentas telah dijalankan ke atas kanak-kanak dengan disleksia daripada sekolah bantuan kerajaan dan Persatuan Disleksia Malaysia. Para peserta kanak-kanak telah dibahagikan kepada dua kumpulan yang dinamakan lebih muda (4 hingga 10 tahun) dan lebih tua (11 hingga 17 than), dan telah dipilih secara rawak. Kemahiran motor kasar telah diukur menggunakan Ujian Kemahiran Motor Bruininks-Oseretsky, Edisi Kedua (BOT-2) (sub ujian: Koordinasi Badan, dan Kekuatan dan Daya Tahan) dan Bateri Penilaian Pergerakan untuk Kanak-kanak, Edisi Kedua (MABC-2) (sub ujian: Tuju dan Tangkap). Skor piawai dan pangkat persentil telah digunakan untuk analisis statistik. Keseluruhan 82 orang kanak-kanak dengan disleksia telah diambil untuk kajian ini, termasuk kanak-kanak lebih muda (n = 57) dan kanak-kanak lebih tua (n = 25). Kanak-kanak yang lebih muda menunjukkan prestasi rendah yang signifikan di dalam kemahiran motor kasar di dalam Koordinasi Badan (Median = 48, IQR = 26-63), berbanding kanak-kanak yang lebih tua (Median = 54, IQR = 30-77), dengan saiz kesan yang kecil (r = -.25). Tiada perbezaan yang signifikan didapati untuk hasil dapatan yang lain. Kanak-kanak yang lebih tua didapati menunjukkan kemahiran motor kasar yang lebih tinggi. Kajian ini mencadangkan keperluan bagi program intervensi awal untuk kanak-kanak dengan disleksia yang lebih muda. Kajian masa hadapan yang mengukur kemahiran motor kasar menggunakan reka bentuk longitudinal adalah dicadangkan untuk menyiasat perubahan dalam prestasi kemahiran motor kasar melangkaui masa.

Kata kunci: Penilaian; koordinasi badan; kanak-kanak; motor kasar

INTRODUCTION

Dyslexia refers to a specific difficulty in reading. It is included in a group of neurodevelopmental disorder "specific learning disabilities" with dysgraphia and dyscalculia in the Diagnostic and Statistical Manual of Mental Disorder, Fifth edition (DSM-5) (American Psychiatric Association) (APA 2013). The difficulties were presumed to be not due to low education attainment and/or intelligence (Shu Sze A. C. et al 2018). Beside reading difficulties, children with dyslexia can have a significant motor skills deficit (Okuda et al. 2014; Tubele 2012; Silva et al. 2012). Problems in gross and fine motor skills in children with dyslexia can further affect their quality of life as a good motor proficiency is required to function independently (Clark 2007) and live a healthy life (Lopes et al. 2011; Lubans et al. 2010). Limitations in physical activities including self-care such as buttoning, school work such as handling pencils, and cutting, and social activities with friends such as running, catching, and jumping were affected among those with dyslexia (Okuda et al. 2014).

Studies reported that children with dyslexia are having challenges in motor control ability during body balance, movement automaticity, and rhythm and speed (Rochelle & Talcott 2006; Stoodley & Stein 2011; Valdois 2010). Ability to move the body, stabilize and control the movement are parts of gross motor skills (Cools et al. 2007). Gross motor skills involve the use of large muscles of trunk, arms, and legs. There are a number of studies investigated the gross motor skill performance in children with dyslexia (Brooke et al. 2010; Okuda et al. 2014; Tubele 2012). Cerebellar deficit theory proposed that these motor control difficulties in children with dyslexia are closely related to impairments in the cerebellum, as there were impaired circuits in corticostriatal and corticocerebellar system in children with dyslexia as compared to normal brain (Nicolson et al. 1999; Ramus et al. 2003). As such, the motor sequential activities, balance and adaptive timing were affected in most of the children with dyslexia.

Moreover, till to date, studies on the non-literacy symptoms among dyslexia population in Malaysia are still limited. A previous study had suggested that multidisciplinary approach should be taken to identify of problems associated with dyslexia for early diagnostic and intervention (Hendriksen et al. 2007). Therefore, an early screening for motor skills performance is required to assist an early intervention programme, as the symptoms of dyslexia can be identified in children as early as four years old (Aina Mariana 2010). Study had found that children achieved the most basic movement skills at the age 8 years old due to changes occurred in neurological level (Piek et al. 2010). So, it is suggested that, the older children, with 11 years old and above were more skillful than the younger children. It was reported that the children with dyslexia had slow motor development in early age (Westendorp 2014). However, there is limited knowledge of differences in gross motor skills particularly on the body coordination performance between young and older children with dyslexia. It is expected that the older age children with dyslexia in this study have better motor skills performance compared to the younger children. In addition, this study will be reported the findings of gross motor skills performance from the BOT-2 and MABC-2 that are commonly used for children with learning disabilities and developmental coordination disorders, and first time using in research among children with dyslexia in Malaysia.

According to an age-effect study, motor impairment decreases after adolescence (Brookes et al. 2010). Furthermore, poor performance in motor skills during pre-school age can occur due to specific impairment such as developmental coordination disorder or lack of motor experience (Gottlieb 2001). As children grow older, they are required to perform more complex tasks of daily activities and other physical functioning (Piek et al. 2012). Therefore, the aims of this study were to determine the gross motor skills performance among children with dyslexia, and to compare the gross motor skills between younger and older children.

EXPERIMENTAL METHODS

PARTICIPANTS

This study was conducted on 82 children with dyslexia ranging from 4 to 17 years old. The sample size was estimated based a confidence interval of 95%, a level of precision of 7% and a prevalence of 12% (Singh et al. 2017) using the single proportion formula (Lwanga & Lemeshow 1991). All participants included in this study were recruited from 2 centers of Dyslexia Association Malaysia and 26 Special Education Programs in government schools in the Federal Territory, Kuala Lumpur. They received dyslexia diagnosis from the pediatrician/doctor prior entering the centers and schools. The participant selection was based on the diagnosis received and identified by senior/coordinator of special education teacher at the centers or schools for having dyslexia characteristics that based on the DSM (5) criteria. Children who were diagnosed other than dyslexia (i.e. intellectual disability, autism, developmental delay) or having concomitant disorders such as ADHD (attention-deficits/hyperactivity disorder) were excluded from this study. None of the children had physical, visual or hearing disabilities. The participants were randomly chosen into age strata (younger (4 to 10 years old), and older (11 to 17 years old).

INSTRUMENT

Bruininks-Oseretsky Test of Motor Proficiency, second edition (BOT-2) The BOT-2 is reliable (reliability coefficients: 0.80's, inter-rater reliability: 0.90s) and valid to measure fine and gross motor skills development (Bruininks and Bruininks 2005). It is used to identify the severity of motor components in children aged from 4 to

21 years old. In this study, only gross motor components (Body Coordination (Subtest: Bilateral Coordination), and Strength and Agility (Subtest: Running speed and Agility, and Strength)) were assessed using the BOT-2 Complete Form. The Balance subtest in Body Coordination test was excluded in this study, and can be obtained in the future study that focusing on balance issues. The scores obtained in each subtest were recorded and converted into equivalent age and into descriptive category (classification) of motor performance (i.e. well-below average, below average, average, above average, and well-above average) based on the United States (US) population norms. A higher score indicates a better motor performance.

Movement Assessment Battery for Children, second edition (MABC-2) The MABC-2 measures the risk of motor impairment for three age bands: Band 1 (3 to 6 years), Band 2 (7 to 10 years), and Band 3 (11 to 16 years) (Henderson *et al.* 2007). The MABC-2 Test Record Form for Aiming and Catching was used in this study. For scoring, a norms table is used to determine the percentile of the total test score. The percentile rank was determined using the norms table. The percentile scores of less or equal to 5th percentile represent a significant motor impairment or movement difficulties (red zone). The percentile scores between the 5th and 15th indicate that the child is "at risk" for a motor impairment (amber zone). Finally, the percentile scores of more than 15th percentile represent no motor impairments (green zone).

PROCEDURES

This study was approved by the Medical Research and Innovation Secretariat, the Universiti Kebangsaan Malaysia (NN-2016-060), the Ministry of Education Malaysia (KPMSP.600-3/2/3 Jld 7) and the State Education Department of Wilayah Persekutuan (JPNWP.900 – 6/1/7).

A convenience sample of children with dyslexia (n = 82) were participated in this study. Prior to data collection, the children were screened based on the inclusion and exclusion criteria as mentioned earlier. Next, the researchers obtained consent from the parents of the selected children. After the consent had been obtained, the parents were asked to fill up a socio-demographic questionnaire for both parents and children. The children's gross motor skills were assessed using the Bruininks-Oseretsky Test of Motor Proficiency, second edition (BOT-2), and the Movement Assessment Battery for Children, second edition (MABC-2). Instructions and test administration were given following the manual guideline and protocol from both tests. To avoid order bias, different sets of arrangements were used. The children were divided into two groups. The first group was assessed using the BOT-2, followed by the MABC-2, and vice versa for the second group. An interval break at least one minute between tasks was implemented to avoid fatigue. Another five minutes of break were given if they need more time. The assessment was carried out by the first and fourth authors from Mac to July 2016 at the Dyslexia Association of Malaysia and government schools that offer special education program in Kuala Lumpur.

DATA ANALYSIS

Statistical analysis was conducted using the Statistical Program of Social Sciences (SPSS) software for Windows (version 23.0). Descriptive analysis was used to describe the measures of central tendency and variability of the children's gross motor performance in the BOT-2 (Body Coordination (subtest: Bilateral Coordination), Strength & Agility (subtests: Running Speed and Agility, Strength), and the MABC-2 (Aiming and Catching). The BOT-2 and the MABC-2 standard scores and percentile rank from each subtest were calculated. A descriptive analysis of gross motor performance in younger and older children with dyslexia also were presented in table. Further analysis using Mann-Whitney U Test was conducted to compare the differences in BOT-2 standard scores and MABC-2 percentile scores between the age groups. The alpha levels were set at $p < .05$. There was no attrition throughout the study.

RESULTS

Eighty-two children (54 males and 28 females) with dyslexia participated in the study. The mean age of the participants was 9.42 (SD = 3.28), consisting of younger (n = 57, 69.5%) and older children (n = 25, 30.5%). Most of the children were Malays (n = 65, 79.3%), followed by Chinese (n = 10, 12.2%), Indians (n = 4, 4.9%), and others such as Punjabis (n = 3, 3.7%). More than half of the participants (n = 42, 51.2%) were recruited from government schools program, either from the Integrated or Inclusive Special Education, while the other 48.8% (n = 40) of the participants were recruited from the Dyslexia Association Malaysia. Table 1 shows the demographic characteristics of the participants.

GROSS MOTOR PERFORMANCE

In general, the participants had an average performance of the BOT-2 Body Coordination (*Mean* = 52.06, SD = 11.28) and Strength and Agility (*Mean* = 43.55, SD = 9.72). Meanwhile, for the MABC-2 Aiming and Catching, the mean percentile was 2.34 (SD = 0.87). Table 2 demonstrates the mean and standard deviation of the BOT-2 and the MABC-2 standard scores and percentile ranks.

The maximum point scores, mean and standard deviation of the BOT-2 subtests of Bilateral Coordination, Running Speed and Agility, and Strength are reported in Table 3. In the Bilateral Coordination subtest, the most difficult item was jumping in place for opposite side synchronized (*Mean* = 2.16, SD = 1.08). For Running Speed and Agility, the most difficult item was one-legged side hop

TABLE 1. Demographic characteristics of participants (N = 82)

Participants	Frequency (n = 82)	Percentage (%)	Mean	SD
Gender				
Male	54	65.9		
Female	28	35.1		
Age			9.42	3.28
Age group				
Younger children (4 to 10 years old)	57	69.5		
Older children (11 to 17 years old)	25	30.5		
Race				
Malay	65	79.3		
Chinese	10	12.2		
Indian	4	4.9		
Others (e.g. Punjabi, Kadazan, etc.)	3	3.7		
Types of school				
Dyslexia Association Malaysia	40	48.8		
Government schools program (Integrated/ Inclusive Special Education)	42	51.2		

TABLE 2. The mean and standard deviation of BOT-2 and MABC-2 standard scores and percentile ranks (N = 82)

Variables	Standard Score		Percentile rank		Descriptive category
	Mean	SD	Mean	SD	
BOT-2 (Body Coordination)	52.06	11.28			Average
BOT-2 (Strength and Agility)	43.55	9.72			Average
MABC-2 (Aiming and Catching)			2.34	0.87	Movement difficulties

TABLE 3. The mean and standard deviation of BOT-2 subtest point scores for bilateral coordination, running speed & agility and strength

BOT-2	Max. Point Score	Mean	SD
Bilateral Coordination			
Touching nose with index fingers – eyes closed	4	3.90	0.50
Jumping jacks	3	2.67	0.70
Jumping in place – same sides synchronized	3	2.91	0.48
Jumping in place – opposite sides synchronized	3	2.16	1.08
Pivoting thumbs and index fingers – same sides synchronized	3	2.26	1.09
Tapping feet and fingers – same sides synchronized	4	3.90	0.49
Tapping feet and fingers – opposite sides synchronized	4	2.99	1.10
Running Speed & Agility			
Shuttle Run	12	5.25	2.49
Stepping sideways over a balance beam	8	4.79	1.07
One-legged Stationary Hop	10	6.01	2.24
One-legged side Hop	10	3.11	2.17
Two-legged side Hop	9	4.70	1.97
Strength			
Standing long jump	12	4.95	2.23
Knee push up OR Full Push up	9	3.49	1.74
Sit Ups	8	3.96	1.82
Wall Sit	6	3.85	1.64
V-Up	6	2.76	1.80

(*Mean* = 3.11, *SD* = 2.17). Another subtest in gross motor from the BOT-2 is Strength. The V up (*Mean* = 2.76, *SD* = 1.80) item was the most difficult item carried out by the children in Strength.

Table 4 shows the maximum standard score, mean and standard deviation of the MABC-2 subtest point scores of Aiming and Catching. Throwing beanbag onto mat item had the lowest mean scores for both band 1 (*Mean* = 3.78, *SD* = 1.88) and band 2 (*Mean* = 4.18, *SD* = 2.14). For band 3, the lowest mean score was catching ball with one hand using non-preferred hand.

Table 5 shows the mean and standard deviation of the BOT-2 and the MABC-2 standard scores and percentile ranks, for younger and older children with dyslexia. Both age groups had an average performance of the BOT-2 Body Coordination (younger: *Mean* = 47.44, *SD* = 9.82, older: *Mean* = 54.09, *SD* = 11.37) and Strength and Agility (younger: *Mean* = 42.08, *SD* = 8.33, older: *Mean* = 44.19, *SD* = 10.28). Meanwhile, for the MABC-2 Aiming and Catching, both age groups were categorized as having movement difficulties (younger: *Mean* = 2.16, *SD* = 0.94, older: *Mean* = 2.53, *SD* = 0.78).

TABLE 4. The mean and standard deviation of MABC-2 Standard score for aiming and catching

MABC-2	Max. Standard Score	Mean	SD
Band 1 (3-6 years old)			
Catching beanbag	10	7.43	1.90
Throwing beanbag onto mat	8	3.78	1.88
Band 2 (7-10 years old)			
Catching with two hands	10	6.62	3.07
Throwing beanbag onto mat	9	4.18	2.14
Band 3 (11-16 years old)			
Catching ball with one hand (preferred hand)	10	5.28	2.91
Catching ball with one hand (non-preferred hand)	10	4.22	3.25
Throwing ball at mounted target	11	5.28	2.56

GROSS MOTOR SKILLS PERFORMANCE IN YOUNGER AND OLDER CHILDREN WITH DYSLEXIA

Table 6 shows the comparison of motor performance between younger and older children. The younger children were found to have a significantly lower performance in gross motor skills compared to the older children especially in Body Coordination. The significant difference between the two groups can be observed for Body Coordination (r = -.25, small effect size).

DISCUSSION

This study examined the gross motor skills performance of children with dyslexia, and compared the gross motor skills between younger and older children. The current study showed that children with dyslexia had movement difficulties in Aiming and Catching. The most difficult items in each subtests were also discussed. The main finding emphasized in the present study was that older children were having significantly higher gross motor skills in Body Coordination compared to younger children.

TABLE 5. The Mean and Standard Deviation of BOT-2 and MABC-2 Standard scores and Percentile ranks for younger and older children with dyslexia

Variables		Standard Score		Percentile rank		Descriptive
		Mean	SD	Mean	SD	category
Younger (n = 57)	BOT-2 (Body Coordination)	47.44	9.82			Average
	BOT-2 (Strength and Agility)	42.08	8.33			Average
	MABC-2 (Aiming and Catching)			2.16	0.94	Movement difficulties
Older (n = 25)	BOT-2 (Body Coordination)	54.09	11.37			Average
	BOT-2 (Strength and Agility)	44.19	10.28			Average
	MABC-2 (Aiming and Catching)			2.53	0.78	Movement difficulties

TABLE 6. Comparison of gross motor skills performance using the BOT-2 and the MABC-2 for younger and older children groups

Variable	Groups (Mdn, IqR)				
	Younger	Older	*Z*	*P*	*r*
BOT-2 (Body Coordination)	48 (26-63)	54 (30-77)	-2.28	0.02	-.25*
BOT-2 (Strength and Agility)	41 (26-60)	42 (23-73)	-.77	0.44	-.09
MABC-2 (Aiming and Catching)	3 (1-3)	3 (1-3)	-.21	0.83	-.02

*$p < 0.05$, r is used as effect size

GROSS MOTOR SKILLS PERFORMANCE

This study found that there are more male than female children with dyslexia. This finding is similar with previous studies, where a higher prevalence of dyslexia was found in male children (Arnett et al. 2017; Badalà et al. 2008; Rosana Awang Bolhasan 2009). The Voxel-Based Morphometry (VBM), a technique done by manual tracing to examine the brain anatomy in MRI was employed to prove the abnormalities in the brain, which usually done on male children (Badalà et al. 2008). There are limited number of studies on female children with dyslexia, which may detect the abnormalities in the brain for female children with dyslexia (Badalà et al. 2008). However, another study addressed that the processing speed and inhibitory control of the brain were different between male and female in dyslexia (Arnett et al. 2017).

Difficulties in Aiming and Catching were consistent with a previous study which reported that children with dyslexia had greater difficulty in coordination and precision of movement which might affect the daily functioning such as playing ball (Okuda & Pinheiro 2012). It was reported that these groups of children had more problems in "timing" tasks compared to typical children (Waelvelde et al. 2004). Therefore, ball catching was continuously used in many motor assessments to measure motor proficiency in children with disabilities. Other studies indicated that the presence of dyslexia also impaired the balance, motor control, rhythm and speed, and automatization of movement (Okuda et al. 2014; Rochelle & Talcott 2006; Stoodley & Stein 2011). The findings from this study suggest that early intervention for children with dyslexia should emphasize on aiming and catching or ball skills in order to encourage motor development at an early age.

The current study also highlighted the most difficult item for each BOT-2 subtests for Bilateral Coordination, Running speed and Agility, and Strength. Jumping in place for opposite side synchronized was the lowest score in Bilateral Coordination. This item required the children to jump in place while moving side arms and legs alternately (right arm moves synchronous to left legs, and vice versa). The motor cortex, cerebellum and basal ganglia in the brain controlled the bilateral coordination movement, which was associated with memory and learning ability (Siminghalam et al. 2016). There is also evidence from a previous study that children with dyslexia had a problem to perform complex imitations of movement tasks (Ozbič & Filipčič 2010). The children had to cross the vertical midlines of their bodies. Therefore, this study suggests that children with dyslexia may have difficulty to perform the added complexity of bilateral coordination, especially in synchronized movement of legs and arms alternately.

In addition, one legged side hop was the lowest score in Running Speed and Agility subscale. To perform this movement, the children had to hop back and forth over the line using one leg. In a previous study, children with dyslexia were reported having difficulties in motor skills including hopping (Nicolson & Fawcett 1995). In addition, this movement requires muscle strength, neuromuscular control, and confidence in the limb (Nicolson & Fawcett 1995). Thus, one-legged side hop task can be a difficult task for them to perform easily due to balance difficulty.

Other than that, V up item or a prone extension exercise in Strength subscale was the lowest score in most children with dyslexia. This task is mainly used for vestibular testing. Prone extension was assumed to be a static vestibular function (Pienaar et al. 2007). Meanwhile, balance and postural stability have been proposed as an important indicator of dyslexia risk (Fawcett & Nicolson 2011). Therefore, the inability to perform this task can be due to balance problem which demonstrates reliable deficits in motor skills. Furthermore, the combination of vestibular, visual and proprioceptive systems is essential for body reflexes and to maintain body posture (Pienaar et al. 2007). Therefore, this study suggests that prone extension tasks should be considered to be included in motor assessment.

In the MABC-2 subtest, the current study found that the most difficult item for each age band was the throwing target tasks, such as throwing bean bag onto mat and throwing ball at mounted target. Throw to target requires good postural control, vision, balance, eye-hand coordination and fine movement of the hands. To perform catch ball, ability to use an appropriate force and timing of hand movements must be adjusted to the speed, direction, weight, and size of the ball (Waelvelde et al. 2004) which is in conjunction with the current findings that found that lacking in ball skills are the foremost problem in children with dyslexia.

AGE-RELATED MOTOR IMPAIRMENT

The current study shows that older children have a significantly better performance in Body Coordination especially bilateral coordination tasks than younger children. This result supports the previous study findings mentioned that, growing age was correlated to children's gross motor competence (Barnett et al. 2016). It was also reported that, there is changes in body composition, hormonal status and physical fitness in older children above age of 11 years which mostly affected by the puberty (Goswami et al. 2014). Another study also mentioned that, the development of motor in children post puberty were more influenced by practice and opportunity (Goswami et al. 2014). Therefore, most children with dyslexia in this study were get higher scores in bilateral coordination as they were more chances in physical activities including jumping jacks and jumping synchronized during physical exercise session, and engagement in movement activities in school environment.

The foundation of good bilateral coordination is the integration process of vestibular and proprioceptive sensations, and the efficiency of interhemispheral connections for both sides of the body (Ayres 1972).

Kauffman (1983) said, there is evidence that some skills were expected to achieved at later age of 7 years, such as alternate foot tapping and jumping jacks. Meanwhile, alternate hops should be expected at the age of 8 years. To date, there is no similar study to age expectations for accurate performance of this motor task or to the factors that contribute to acquisition of this skills.

The current study also found no significant differences between Strength and Agility, and Aiming and Catching subtests correlated to age. It showed that both younger and older children with dyslexia have lower performance in those subtests. However, in the BOT-2, there have a ceiling effect, which difficult to identify age differences between both groups. There are different maximal performance between younger and older children. Meanwhile, in the MABC-2, there have fewer and simpler tasks to assess the Aiming and Catching test in younger children. Therefore, it is difficult to see the differences between both groups. The previous study done by Westendorp et al. (2014) reported that no age effect was seen in locomotor skills as measured using the test of Gross Motor Development (TGMD). Most likely, similar items in these two instruments makes this result comparable. It was also reported that a longitudinal study on gross motor development in children with learning disabilities has not yet been conducted (Westendorp et al. 2014). The development of gross motor skills in children is essential to increase participation in physical activities along with the growth of cognitive abilities (Westendorp et al. 2014). This study suggested that future investigation on age comparison for gross motor skills among children with dyslexia should be considered.

This study includes the unequal proportion of younger and older children which may influence the group variance and also the lack of race diversity among participants, where mostly Malay children had taken part in this study. Future studies investigating gross motor skills using longitudinal design is recommended to investigate the effect of age on gross motor performance in children with dyslexia.

The findings of the current study suggest several clinical implications for clinicians and researchers. For clinicians, gross motor performance is an important factor in rehabilitation strategies for children with dyslexia. It is necessary to assess this problem to determine the needs for rehabilitation. Researchers might consider the importance of age–effect in assessing children with dyslexia as essential factors towards future studies on health care management among health care professionals who are handling children with learning disabilities. The motor performance skills between the US population and Malaysian might differ due to societal and environmental influences.

CONCLUSION

In conclusion, the present study suggests that the older children were found to demonstrate a higher level of gross motor skills. Thus, this study recommends that intervention that address gross motor skills is necessary during an early intervention program for children with dyslexia.

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