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Convergent Validity between Two Motor Skills Tests Used to Assess Motor Functions in Children with Learning Disabilities and Intellectual Disabilities

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Abstract

Competence in the motor domain and satisfactory motor skills show children to interact with their surrounding environment and play important roles to engage in daily occupations. The most common form of motor skill assessment is the use of performance-based tests. Despite its widespread current use in research and its potential for clinical application, there is litter research on convergent validity of the Movement Assessment Battery for Children (MABC) and Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) for typically developing school-aged children. The agreement between these two tests for children with learning disabilities (LD) and intellectual disabilities (ID) is still not known. The aim of this study was to investigate the convergent validity between these two assessment tools for children with learning disabilities (LD) and intellectual disabilities (ID). 50 participants was recruited (8 subjects with intellectual disabilities and 42 subjects with learning disabilities). The Pearson correlation showed that the MABC (or MABC-2) was significantly associated with the BOTMP (or BOT-2) for both gross motor test items and fine motor test items. The MABC and BOTMP appear to assess associated motor skill abilities in children with intellectual disabilities and learning disabilities.

Keywords

Convergent validity, school-aged children, learning disabilities, intellectual disabilities

1. Introduction

Occupational therapy focuses on clients' ability to engage in daily occupation. By assessing children's execution of skills and performance patterns, pediatric occupational therapists need to identify the differences between children's ability and the demands of the occupation (Case-Smith, 2010; Stewart, 2010). A common area of evaluation and intervention is motor skill performance (Kennedy, Brown, & Stagnitti, 2013). So, it is imperative that clinicians, therapists, and researchers accurately assess performance in the motor domain.

Motor skills can be defined as goal-directed patterns of movement that meet the requirements of a task and refer to the body's ability to manage the process of movement (Radomski & Trombly Latham, 2008). Motor skill is a function, which involves the precise movement of muscles with the intent to perform a specific act and can be divided into areas of gross and fine motor skills. Gross motor skills include whole-body movements and require the use of large muscle groups to perform. Fine motor skills include in-hand manipulation and grasping objects. It involves the use of small muscles of the hand with the wrists, hands, fingers for controlled movements. The development and enhancement of proficient motor skills is a fundamental aspect of childhood as they allow children to interact with and explore their surrounding environment, and engage in daily occupations at home, at school, and in the community such as dressing, eating, toileting, functional mobility, taking part in leisure pursuits, handwriting, and using technology (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009; Cools, De Martelaer, Samaey, & Andries, 2009; Cool, De Martelaer, Vandaele, Samaey, & Andries, 2010; D'Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2009; Jaikaew & Satiansukpong, 2019; Lopes, Rodrigues, Maia, & Malina, 2011; Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Wang, Tseng, Wilson, & Hu, 2009).

Children with fine and gross motor difficulties have been found to have lower perceptions of their self-worth, less physical competence, visual perceptual deficits, and higher levels of anxiety relative to their typically developing peers (Piek, Baynam, & Barret, 2006; Piek, Michelle, Barrett, & Coleman, 2000; Skinner & Piek, 2001; Van Waelvelde, De Weerdt, De Cock, & Smits-Engelsman, 2004a; Wang, Tseng, Wilson, & Hu, 2009). Children with intellectual disabilities (ID) and learning disabilities (LD) are common characterized by fine and gross motor skill deficits and impairments of sensorimotor functions that impede the quality and quantity of their participation or performance in activities in school, at home, and in the community (Dolva, Coster, & Lilja, 2004; Hogan, Rogers, & Msall, 2000; Wuang, Wang, Huang, & Su, 2008). These motor difficulties may hinder their participation in daily activities, academic performance, independence in daily living and social acceptance by peers (Dolva, Coster, & Lilja, 2004; Pivik, Mccomas, & Laflamme, 2002). So, early recognition of children's motor problem is very important not only to provide support for the children and parents as early as possible but also to prevent the development of concomitant problems, e.g. psychosocial problems.

To accurately identify and examine children's motor difficulties, a formal standardized motor test should be included. It is essential that motor skills assessments have documented evidence of validity and reliability. As Tieman, Palisano, and Sutlive (2005) and Jaikaew and Satiansukpong (2019) point out, valid and reliable motor testtools are essential for clinicians, therapists, and teachers, not only as part of the identification process but also as a means of evaluating progress in motor development, choosing a tool for clinical setting or research, and assessing the efficacy of interventions (Kimberlin & Winterstein, 2008). Validity can be defined as an evaluative summary of both the evidence for and the actual－as well as potential－consequences of score interpretation and use. Convergent validity indicates a correspondence between measurers of the same construct (Messick, 1995). Convergent validity also means that two measures that are believed to be related will yield similar results and refers to the extent to which different measures of the same construct are in fact related (Fransen, D'Hondt, Bourgois, Vaeyens, Philippaerts, & Lenoir, 2014). A high convergent validity between two test batteries should result in a high agreement of classification based on both measurement instruments (Cool, De Martelaer, Vandaele, Samaey, & Andries, 2010).

Two assessment tools are often used in a large range of studies to assess motor competence of children of various ages in research settings: the Movement Assessment Battery for Children (MABC) (revised as the Movement Assessment Battery for Children–Second edition,MABC-2, in 2007) and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (revised as the Bruininks-Oseretsky Test of Motor Proficiency–Second edition,BOT-2,in 2005). Compared with the MABC (or MABC-2), the BOTMP (or BOT-2) is a detailed motor skill assessment that often takes about forty to sixty minutes to administer. On the contrary, the MABC (or MABC-2) takes less time and is easier to administer and can be regarded as a screening test. Though the different theoretical frameworks of the two test tools are expressed in different test structures, there are some similar subtest items that assess same movement skills. As both the two assessment tools are used by therapists to measure motor skill performance of children with intellectual disabilities (ID) and learning disabilities (LD) (Elstner, 2015; Nur Sakinah Baharudin, Dzalani Harun, & Masne Kadar, 2020; Vuijk, Hartman, Scherder, & Visscher, 2010; Wuang, Su, & Huang, 2012), there is a need to determine how performance on these different assessments is associated (Logan, Robinson, & Getchell, 2011). Determining whether the Movement ABC is correlated with BOTMP would provide helpful information in terms of the potential demands made on children being assessed and the time taken to complete motor skill assessments.

Reviewing the literature, convergent validity data for the MABC (or MABC-2) can be found in recently published studies (Cool, De Martelaer, Vandaele, Samaey, & Andries, 2010; Croce, Horvat, & McCarthy, 2001; Kakebeeke, Egloff, Caflisch, Chaouch, Rousson, Largo, & Jenni, 2014; Kakebeeke, Knaier, Köchli, Chaouch, Rousson, Kriemler, & Jenni, 2016; Logan, Robinson, & Getchell, 2011; Logan, Robinson, Rudisill, Wadsworth, & Morera, 2014; Smits-Engelsman, Henderson, & Michels, 1998; Spironello, Hay, Missiuna, Faught, & Cairney, 2010; Van Hartingsveldt, Cup, &Oostendorp, 2005; Van Waelvelde, De Weerdt, De Cock, & Smits-Engelsman, 2004b; Van Waelvelde, Peersman, Lenoir, & Smits-Engelsman, 2007a). By the way, the convergent validity between BOTMP (or BOT-2) and related motor assessment tests are also seen in some researches (Croce, Horvat, & McCarthy, 2001; Fransen, D'Hondt, Bourgois, Vaeyens, Philippaerts, & Lenoir, 2014; Spironello, Hay, Missiuna, Faught, & Cairney, 2010; Tan, Parker, & Larkin, 2001).

Though the convergent validity of MABC-2 and BOT-2 for typically developing school-aged children has been done (Lane & Brown, 2015; Spironello, Hay, Missiuna, Faught, & Cairney, 2010), however, the psychometric properties data of the convergent validity of these two motor skill tests in applying to ID and LD populations are scant. It may make it more difficult to precisely interpret the results of motor function measures and to support its used in research and clinical settings for the children with ID and LD. Furthermore, when using the tests outside the original country, it is important to realize that they are potential influence on cultural and geographical difference. Thus, a psychometric property study is needed (Yasir Arafat, zur Rahman Chowdhury, Shalahuddin Qusar, & Hafez, 2016).

To date, though the two assessment tools have been revised, in this study, the subtest items in all age band in the MABC (or MABC-2) and the BOTMP (or BOT-2) are considered due to the two reasons: ① children with intellectual disabilities (ID) and learning disabilities (LD) are usually characterized by delays in motor milestone of gross and fine motor, though the subjects with aged 7-10 years are selected in this study, the motor functions may lag to lower age band; ② both the two motor tests (MABC vs MABC-2 and BOTMP vs BOT-2) assess children's motor skill constructs in a similar format. And research also show that the reliability and validity of these two motor tests are very good and support that the reliability and validity information reported for the MABC and BOMPT is generalizable to the MABC-2 and BOT-2 (Croce, Horvat, & McCarthy, 2001; Wuang, Su, & Huang, 2012).

The purpose of this study is to examine the convergent validity of the MABC (or MABC-2) and BOMPT (or BOT-2) when completed by school-aged children with LD and ID aged 7-10 years. The research question will be posed: Does MABC (or MABC-2) five gross motor skill subtest scales and three fine motor skill subtest scales significantly correlate with BOMPT (or BOT-2) five gross motor skill subtest scales and three fine motor skill subtest scales when completed by school-aged children with LD and ID aged 7-10 years?

2. Method

2.1 Participants

A sample of 50 students (39 boys and 11 girls with age range of 7-10 years) with 8 students with intellectual disabilities and 42 students with learning disabilities was recruited via convenience sampling from public elementary school. Students with emotional or behavioral disturbances, cerebral palsy, sensory impairments (such as blindness or deafness), or other neurological disorders (such as traumatic brain injury, muscular dystrophies, or epilepsy) were excluded from the study. Students also need to have a level of cognitive development that allows them to understand the test instructions and testing procedures. Informed written consent was obtained from the parents and assent was also obtained from the students.

2.2 Instrumentation

2.2.1 Movement Assessment Battery for Children (Movement ABC or MABC)

The Movement Assessment Battery for Children (Movement ABC or MABC) was released in 1992 (Henderson & Sugden, 1992). The MABC underwent revisions and was published in 2007 as the Movement Assessment Battery for Children–Second edition (MABC-2) (Henderson, Sugden, & Barnett, 2007). The MAB C–2 is a validated, norm- referenced, and product-oriented motor assessment that quantitatively assesses motor competence in children between the ages of 3 and 16 years. Performance is based on the product of movement such as the number of successful trials or the time taken to complete a task (Henderson, Sugden, & Barnett, 2007).

The battery is composed of two separate parts: the Performance Test and the Checklist. The Performance Test includes three motor skill areas: Manual Dexterity, Aiming and Catching, and Balance. The MABC-2 is also split into three age-bands: AB1 (3-6 years), AB2 (7-11 years), and AB3 (11-16 years). Each age-band is composed of eight subtest items that fall under the three skill areas.

The MABC (or MABC-2) psychometric property studies have also been increasing for over a decade. Test-retest reliability for MABC was reported in published studies: 0.95 (range from 0.92 for children 9-10 years old to 0,98 for children 5-6 years old) (Croce, Horvat, & McCarthy, 2001), 0.88 (Van Waelvelde, Peersman, Lenoir, & Smits-Engelsman, 2007b). Interrater reliability for MABC were also done: 0.95 to 1.00 (Smits-Engelsman, Fiers, Henderson, & Henderson, 2008). Chow & Henderson (2003) noted that the test-retest reliability for MABC was 0.77 and interrater reliability was 0.96. Using the standard scores for the three performance test sections (Manual Dexterity, Aiming and Catching, and Balance) as well as the total test score, Henderson, Sugden, & Barnett (2007) found the

Pearson Product Moment correlations were 0.77, 0.84, 0.73, and 0.80 respectively. Wuang, Su, & Su (2012) noted that internal consistency for the MABC-2 Test was α= 0.90 and test–retest reliability had an intraclass correlation coefficient of ICC = 0:97 for children with DCD. Similarly, Wuang, Su, & Huang (2012) reported that the internal consistency of MABC-2 was α=0.88 and the test–retest reliability was 0.96. Other studies also showed consistent results for reliability. Test-retest reliability was good in both typical children (ICC = 0:83-0.98) (Hua, Gu, Meng, & Wu, 2013). Internal consistency reliability was also in an acceptable range (Cronbach's alpha = 0:50-0.70) (Hua, Gu, Meng, & Wu, 2013; Kita, Suzuki, Hirata, Sakihara, Inagaki, & Nakai, 2016; Ellinoudis, Evaggelinou, Kourtessis, Konstantinidou, Venetsanou, & Kambas, 2011). Smits-Engelsman, Niemeijer, & Van Waelvelde (2011) also established a acceptable to good internal consistency (Cronbach's alpha ranged from 0.70 to 0.87). A study of 844 Brazilian children, aged 6-11 years, recorded a good interrater reliability(ICC = 0:86 to 0.99) and intrarater reliability(ICC = 0:68 to 0.85) (Valentini, Ramalho, & Oliveira, 2014). The study on 45 children, aged 7-9 years, found poor to moderate interrater reliability (ICC = 0:35 to 0.67) and intrarater reliability (ICC = 0:23 to 0.76) (Holm, Tveter, Aulie, & Stuge, 2013). Most of the above information supported that the MABC2 was suitable for detecting movement difficulty in children.

Regarding the validity of the MABC (orMABC-2), Croce, Horvat, & McCratty (2001) showed high concurrent validity correlation coefficients between M-ABC and Bruininks-Oseretsky assessment protocol (Pearson r = 0.77 to 0.79 for 5 to 6 year olds). According to the reports seen the study from Henderson, Sugden, & Barnett (2007), the Manual Dexterity section was correlated with the Aiming and Catching section (0.26), Balance section (0.36), and MABC-2 Total Test Score (0.76). The Aiming and Catching section was correlated with the Balance section (0.25), and the total test score (0.65). The Balance section was correlated with the total test score (0.73). Lane & Brown (2015) reported that concurrent validity of the MABC2-Age Band 3, with the BOT-2, was good (r = 0:80) and the MABC2-Age Band 1, with PDMS-2, was moderate (r = 0:63) (Hua, Gu, Meng, & Wu, 2013). Previous construct validity of the MABC2 in Greek, German, and Japanese studies showed equal validity to the original UK version (Wagner, Kastner, Petermann, & Bös, 2011; Kita, Suzuki, Hirata, Sakihara, Inagaki, & Nakai, 2016; Ellinoudis, Evaggelinou, Kourtessis, Konstantinidou, Venetsanou, & Kambas, 2011).

2.2.2 Bruininks-Oseretsky Test of Motor Proficiency (BOTMP)

The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP; Bruininks, 1978) was published in 1978 and was a standardized, norm-referenced assessment of motor proficiency to identify children with motor skill delays. The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) was designed to evaluate gross and fine motor skills in children between ages of 4.5 and 14.5years of age (Bruininks, 1978), and was already widely used by physical therapists, occupational therapists, psychologists, adaptive physical education teachers, and special education teachers in clinic and school practice settings. The BOTMP underwent revisions in 2002 and published in 2005 as the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) (Bruininks & Bruininks, 2005). The BOT-2 is an individually administered measure of a wide variety of fine and gross motor skills performance of both typically developing children and adolescents and children and adolescents with mild to severe motor coordination problem from 4 to 21 years of age (Bruininks & Bruininks, 2005). The test measures motor development 4 motor-area composites with 53 items grouped into these 8 subtests, including Fine Manual Control, Manual Coordination, Body Coordination, and Strength and Agility.

Findings from a reliability study showed that the BOT-2 was reported to have moderate to strong inter-rater and test-retest reliability for both complete and short forms. The BOT-2 showed split-half reliability for internalconsistency and reliability coefficients for the subscale composite, total motor composite and short form scores that range from high 0.70 s to mid-0.90 s (Deitz, Kartin, & Kopp, 2007). The BOT-2 manual stated that excellent interrater reliability was 0.98 (0.92 for Manual Dexterity subtest and 0.99 for Upper Limb Coordination subtest) (Bruininks & Bruininks, 2005). Cools, De Martelaer, Samaey, & Andries (2009) also reported that good inter-rater reliability for the BOT-2 has been demonstrated with Pearson's correlation coefficients ranging from 0.92 to 0.99. By the way, Wuang, Su, & Huang (2012) reported that the internal consistency of BOT-2 was α=0.86 and the test–retest reliability was 0.97. Wuang & Su (2009) noted that excellent test-retest reliability (ICC=0.99) and internal consistency (α=0.92) for the BOT-2 for children with intellectual disabilities were seen and were sensitive to changes in children with ID.

When compared with the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP; the previous version of the BOT-2), correlation with the BOT-2 were between 0.45 and 0.73 for subtest and composite scores, and strong correlations exist for the total motor composite score and the BOTMP total score (Bruininks & Bruininks, 2005). Venetsanou, Kambas, Aggeloussis, Serbezis, & Taxildaris (2007) compared the consistency of the Short Form (SF) and the Long Form (LF) of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) in identifying preschool children with motor impairment (MI) and Pearson's product–moment coefficients (r=0.85) showed that the correlation between SF and LF total composite scores was high (95% CI, r=0.80–0.89).

2.3 Procedure

As the participants were not old enough to provide informed consent, permission was sought from the parents of the children. Participant information letters and consent forms were attached to home with students and teachers forwarded the returned consent forms to the researcher. Verbal assent was also obtained from the students who took part in the study. The researcher ensured that the participants understood the study processing and were able to follow the testing consequences during the period of data collection. Testing was taken part in the therapy room at school to minimize distractions and extraneous influences. All subtest items of gross and fine motor in the two test tools were made at the same time of a day. Each child was tested individually on the eight subtests (five subtests for gross motor and three subtests for fine motor). Testing lasted approximately 60 minutes, with a few minutes of breaks to minimize the effects of fatigue and frustration. The tests were administered and scored in accordance with instructions provided in the respective test manuals. All children were tested by researcher. After the tests were completed, the scores were recorded and the data were coded to maintain the confidentiality of the participants. The tests score results were provided to parents of children in the form of a written letter. The parents were also provided with the option of contacting the researcher if they had any questions about their children's performance scores.

In this study, five gross movement skills and three fine movement skills are chosen.8 subtests from both two assessment tools corresponded with the 8 movement skills are manipulated: 5 subtests are gross motor tests (test 1 to test 5) and 3 subtests are fine motor tests (test 6 to test 8). The 8 movement skills in this study and the 8 subtest items in both two tools are summarized in Table 1 and Table 2.

2.4 Data analysis

All data were obtained through the testing administration. For these two tests, scoring was based on quantitative measures such as the number of successful trials and the length of time taken to complete a task. To allow the analyses to be consistent, the raw scores of the 8 tests are analyzed for the purposes of this study.

To evaluate the convergent validity, Pearson product-moment correlation coefficient was calculated for each subtest to explore the relationship between the scores. Where significant correlations were identified by the analysis, the strength of each association was labelled based on correlations coefficients between 0 and 0.25 having a low level relationship, 0.25 and 0.50 having a fair relationship, 0.50 and 0.75 having a moderate to good relationship, and above 0.75 having a good to excellent relationship (Portney & Watkins, 2009).

Table 1. Gross motor skills in both assessment tools

movement skills	subtest items in MABC (or MABC-2)	subtest items in BOTMP (or BOT-2)
Movement skill 1 (test 1): bounce and catch ball with both hands	˙Two-hand Catch (*)	˙Bouncing a Ball and Catching it with Both Hands (*) ˙Dropping and Catching a Ball – Both Hands (**)
movement skill 2 (test 2): bounce and catch ball with one hand	˙One-hand Bounce and Catch(*)	˙Bouncing a Ball and Catching it with Preferred Hand (*) ˙Dropping and Catching a Ball – One Hand (**)
movement skill 3 (test 3): catch ball with both hands	˙Catching Beanbag (*&**) ˙Catching with Two Hands (**)	˙Catching a Tossed Ball with Both Hands (*) ˙Catching a Tossed Ball – Both Hands (**)
movement skill 4 (test 4): catch ball with one hand	˙One-hand Catch (*) ˙Catching with One Hand (**)	˙Catching a Tossed Ball with preferred Hand (*) ˙Catching a Tossed Ball – One Hand (**)
Movement skill 5 (test 5): throw ball into a target	˙Throwing Beanbag into Box (*) ˙Throwing Beanbag onto Mat (**)	˙Throwing a Ball at a Target with preferred Hand (*) ˙Throwing a Ball at a Target (**)
Scoring: ˙test 1 to test 4 ˙test 5	˙number of correctly executed catches (throws) out of 10 attempts ˙number of successfully executed throws out of 10 attempts	˙number of correctly executed catches (throws) out of 5 attempts ˙number of successfully executed throws out of 5 attempts

PS.: (*) – subtest item in MABC or BOTMP
(**) – subtest item in MABC-2 or BOT-2

Table 2. Fine motor skills in both assessment tools

movement skills	subtest items in MABC (or MABC-2)	subtest items in BOTMP (or BOT-2)
Movement skill 6 (test 6): thread beads	˙Threading Beads (*) ˙Threading Beads (**)	˙Stringing Beads with Preferred Hand (*) ˙Stringing Blocks(**)
movement skill 7 (test 7): place pennies in a box with preferred hand	˙Posting Coins (*) ˙Posting Coins (**)	˙Placing Pennies in a box with Preferred Hand (*)
movement skill 8 (test 8): shiftpegs	˙Shifting Pegs by Rows (*)	˙Displacing Pegs with Preferred Hand (*) ˙Transferring Pennies(**)
Scoring: ˙test 6 ˙test 7 ˙test 8	˙number of seconds taken to complete 12 beadsthreading ˙number of seconds taken to complete 12 penniesposting ˙number of seconds taken to complete 12 pegsshifting	˙the number of beads placed correctly in 15 seconds ˙the number of pennies placed into the box correctly in 15 seconds ˙the number of pegsdisplacingcorrectly in 15 seconds

PS.: (*) – subtest item in MABC or BOTMP
(**) – subtest item in MABC-2 or BOT-2

3. Results

Descriptive statistics are summarized in table 3 to show children's movement skill performance. As the table shows, the mean of the test1is the highest and the mean of the test 4 is lowest in both two assessment tools in gross motor skills (means of the test 1 =8.38 & 4.2 respectively and means of the test 4 = 4.86 & 2.08 respectively). However, in fine motor skills, the subjects perform better in test 6 in MABC (mean=48.94") and in test 7 in BOTMP (mean=7.58).

Table 3. Mean and standard deviation (SD) on participant raw score (n=50)

	MABC (or MABC-2)			BOTMP (or BOT-2)		
	mean	SD	range	mean	SD	range
gross motor skill						
test 1	8.38	1.87	3 – 10	4.2	1.16	1 – 5
test 2	7.88	2.59	0 – 10	3.88	1.53	0 – 5
test 3	7.02	2.28	2 – 10	3.46	1.36	1 – 5
test 4	4.86	2.73	0 – 10	2.08	1.56	0 – 5
test 5	5.24	2.85	0 – 10	2.42	1.72	0 – 5
fine motor skill						
test 6	48.94"	16.05	15" – 88"	4.2	2.08	1 – 12
test 7	30.12"	14.03	12" – 70"	7.58	3.19	3 – 15
test 8	29.46"	11.36	15" – 70"	7.36	2.52	3 – 12

※ PS: test 1 – bounce and catch ball with both hands
test 2 – bounce and catch ball with one hand
test 3 – catch ball with both hands
test 4 – catch ball with one hand
test 5 – throw ball into a target
test 6 – thread beads
test 7 – place pennies in a box with preferred hand
test 8 – shiftpegs

※ PS: MABC – The Movement Assessment Battery for Children
MABC-2 – The Movement Assessment Battery for Children – Second edition
BOTMP – Bruininks-Oseretsky Test of Motor Proficiency
BOT-2 – Bruininks-Oseretsky Test of Motor Proficiency – Second edition

Correlations between the two assessment tools both in gross movement skills and fine movement skills are reported in Table 4 and Table 5. High positive strong correlations are found for all five gross motor subtest items between

MABC (or MABC-2) and BOTMP (or BOT-2). The Pearson correlation coefficient (r) ranges from 0.89 to 0.94 ($p<0.001$) (Table 4). There also are significant negative correlations identified between MABC (or MABC-2) and BOTMP (or BOT-2) for all three fine motor subtest items. The Pearson correlation coefficient (r) ranges from −0.83 to −089 ($p<0.001$) (Table 5). Respective high correlation coefficients support good convergent validity and good correspondence of the two assessment tools.

Table 4. Pearson correlations between the MABC (or MABC-2) and BOTMP (or BOT-2) for gross movement skills

	MABC(or MABC-2)				
	test 1	test 2	test 3	test 4	test 5
BOTMP(or BOT-2)					
test 1	0.90***				
test 2		0.89***			
test 3			0.93***		
test 4				0.93***	
test 5					0.94***

PS: *$p<0.05$ ** $p<0.01$ ***$p<0.001$
test 1 − bounce and catch ball with both hands
test 2 − bounce and catch ball with one hand
test 3 − catch ball with both hands
test 4 − catch ball with one hand
test 5 − throw ball into a target

Table 5. Pearson correlations between the MABC (or MABC-2) and BOTMP (or BOT-2) for fine movement skills

	MABC(or MABC-2)		
	test 6	test 7	test 8
BOTMP(or BOT-2)			
test 6	−0.83***		
test 7		−0.86***	
test 8			−089***

PS: *$p<0.05$ ** $p<0.01$ ***$p<0.001$
test 6 − thread beads
test 7 − place pennies in a box with preferred hand
test 8 − shiftpegs

4. Discussion

Pearson correlation coefficient analyses indicated that both gross motor and fine motor movement skills evaluated in both two assessment tools display significant correlations. Strong positive correlation in the good to excellent range for gross motor skill subtest items was found. In contrast to positive correlation coefficient, there was a strong negative correlation in the good to excellent range for fine motor skill subtest items. The reason is that the scoring criteria for five gross motor skill subtest items in both tools are the number of correctly executed catches (throws) out of 10 (or 5) attempts, and the more the balls are caught (or are thrown) the higher the score and the better the motor competence. However, for three fine motor skill subtest items, the scoring criteria are that the number of seconds taken to complete tasks in MABC (or MABC-2) (that is, the fewer seconds taken the faster the motor action) and the number of beads (pennies or pegs) displacing correctly in 15 seconds in BOTMP (or BOT-2) (that is, the more the beads or pennies or pegs are displaced the higher the score and the faster the motor action).

The results suggest that the MABC (or MABC-2) and BOTMP (or BOT-2) do indeed measure a similar motor constructs and support the convergent validity of both test tools. The high correlation observed in this study is also close to previous studies (Crawford, Wilson, & Dewey, 2001; Tan, Parker, & Larkin, 2001). The interpretation of this results can go in two directions. One explanation is that the correlation reflects the tests' overlap in content and supports the assumption that movement skills tasks are dependent upon more than one factor. The alternative explanation is that the extent of common variance supports the assumption of a factor that underlies a 'general motor ability' as described by Burton and Rodgerson (2001). This study was also noted that the correlation coefficient between the gross motor test scores was higher than between the fine motor test scores. These results are consistent with the findings of Cool, De Martelaer, Samaey, & Andries (2009), Cool, De Martelaer, Vandaele, Samaey, & Andries (2010), Fransen, D'Hondt, Bourgois, Vaeyens, Philippaerts, & Lenoir (2014), and Van Waelvelde, Peersman, Lenoir, & Smits-Engelsman (2007a), but are inconsistent with the findings of Land and Brown's study (2015). One possible explanation of this outcome is that the subjects of this study are LD and ID, and there is better gross motor development than fine motor development for these two populations. The small number of fine movement skills tasks included in both tests and the variety in scope of the tasks may also influenced strength of correlation. By the way, though previous research has found that boys score higher on ball tasks and girls score higher on the manual dexterity tasks of the MABC (Junaid & Fellowes, 2006; Ruiz, Graupera, Gutiérrez, & Miyahara, 2003), in this study, the correlation coefficient between the gross motor test scores was higher than between the fine motor test scores without regard to sex.

Using the tools of MABC-2 and BOT-2, Land and Brown (2015) found that the MABC-2 11- to 16-year-old group (age band 3) was significantly associated with the BOT-2; but, there were nosignificant relationships between the MABC-2 7- to 10-year-old group (age band 2) and the BOT-2.The MABC-2 and BOT-2 appear to assess associated motor skill abilities in children aged 11-16 years but not in children aged 7-10. It seems that it is inconsistent with the present study. One possible explanation of this outcome may be attributed to the different population in these two studies. The participants in Land and Brown's study (2015) are typically developing school-age children aged 7-16 years, however, the investigated samples in present study are the groups of children with LD and ID aged 7-10 to correspond with the AB2 age band of the MABC-2 and most of them are at risk for motor impairment. Children with different motor impairments and different age groups might have different motor performance and result in different convergent validity even though same age group tested from similar assessment tools (Crawford, Wilson, & Dewey, 2001; Kakebeeke, Egloff, Caflisch, Chaouch, Rousson, Largo, & Jenni, 2014; Kakebeeke, Knaier, Köchli, Chaouch, Rousson, Kriemler, & Jenni, 2016; Logan, Robinson, & Getchell, 2011; Logan, Robinson, Rudisill, Wadsworth, & Morera, 2014; Smits-Engelsman, Henderson, & Michels, 1998). Furthermore, a child's motor competence is determined by motor abilities and motor skills (Logan, Robinson, Rudisill, Wadsworth, & Morera, 2014; Kakebeeke, Egloff, Caflisch, Chaouch, Rousson, Largo, & Jenni, 2014). One hypothesis is that the motor skills and abilities of children with LD and ID are not will differentiated and do not develop skills well due to their diseases. This discrepancy may also be explained the different findings between this study and Land and Brown's study. So, in clinical assessment, therapists need to be aware that they need to use clinical reasoning to examine multiple sources of information about the child's motor abilities.

The strength of this study is assessing children with age range of 7-10 years even though they are diagnosed with LD and ID. In this age cohort, the development of motor competence contributes highly to the successful engagement in everyday occupation activities. There are several limitations in this study. One, compared with the study by Fransen, D'Hondt, Bourgois, Vaeyens, Philippaerts, & Lenoir (2014), this study mainly relates to the limited number of children. Further work comparing these two instruments on increasing LD and ID number of children should be considered. Second, many children with LD and ID have attention/behavior problems which may influence the results of tests and the validity. Further research should assess the factors of children's attention/behavior problems. Third, in this study, the raw scores of both two tests are used to analyzed and are not converted to standard scores, the may an impact on the correlation of the validity.

5. Conclusions

The results of this study suggested that MABC and BOTMP do indeed measure a similar construct. A good to excellent relationship exists in test items that assessed the same gross and fine motor movement skills between the two assessment tools. Though they focus on different function levels, the two assessment tools still can be applied as complementary instruments for evaluating the motor abilities of children with ID and LD. The M-ABC seems to be a reasonable alternative to be applied when the BOTMP is not feasible because of the high agreement between these two tests (Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2009). Furthermore, Knowing that performance on different assessments is linked is important in occupational therapy practice as it allows for comparison of results, generalization of findings, and measuring the effectiveness of interventions (Logan, Robinson, & Getchell, 2011). However, diagnosis of a child should always be part of an overall assessment plan. Tests can help clinicians in their decisions, but they must be aware that test results can only be generalized with extreme caution. It is very important for clinicians, therapists, and researchers to choose an appropriate assessment based on the purposes of measurement. The choice of one test over another should be made carefully, and limits of reliability and validity of each test should be known before decisions can be made.

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