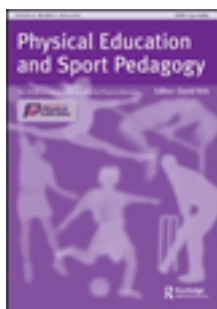


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The comparison of school-age children's performance on two motor assessments: the Test of Gross Motor Development and the Movement Assessment Battery for Children

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Background: Competence in the motor domain is associated with positive, health-related outcomes. Physical education teachers often administer assessments into their programs to measure motor competence for a variety of reasons. Recently, researchers have questioned the relatedness of performance on different assessments.

Purpose: The purpose of this study was to compare motor assessment outcomes of the Test of Gross Motor Development-2 (TGMD-2) and the Movement Assessment Battery for Children-2 (MABC-2) in school-age children.

Method: Sixty-five children ($M = 6.7$ years) completed the TGMD-2 and the MABC-2. The TGMD-2 includes two subscales: object control and locomotor skills. The MABC-2 includes three subscales: manual dexterity, aiming and catching, and balance. Standard scores and percentile rankings were used for analysis.

Findings: Although 10 of the possible 12 Pearson correlations were significant, the range of r^2 values was 0.07–0.27 indicating low practical significance. A paired samples t -test revealed that participants scored higher on the MABC-2 ($M = 42.2$ percentile) compared to the TGMD-2 ($M = 17.2$ percentile, $p < 0.01$). A 2 (sex) $\times$ 3 (grade) MANOVA revealed no significant sex differences on total performance of the TGMD-2 ($F = 0.85$, $p = 0.36$) or the MABC-2 ($F = 0.2$, $p = 0.66$), indicating that boys and girls performed similarly on each assessment. Results also revealed no significant differences on total performance on the MABC-2 ($F = 0.93$, $p = 0.4$) based on the grade level. However, a grade difference was found on the TGMD-2 ($F = 4.3$, $p = 0.02$; $\eta^2 = 0.128$). Tukey's post hoc analysis revealed a significantly higher TGMD-2 performance for first graders compared to second graders ($p = 0.03$). No significant interaction effect was found for either assessment ($p > 0.05$). Results indicate that both assessments agreed on 9 out of 11 possible children as at-risk of Developmental Coordination Disorder (81.8% agreement) and 27 out of 29 children as delayed in the motor domain (93.1% agreement).

Conclusions: The TGMD-2 and MABC-2 measure different aspects and/or levels of motor competence and should not be used interchangeably. Each assessment may be used to complement each other. Given the level of agreement between the TGMD-2 and the MABC-2 to identify children as at-risk of Developmental Coordination Disorder and developmentally delayed in the motor domain, it may be recommended that physical education teachers administer the TGMD-2 as part of annual testing. Physical educators can act as the first line of defense in early

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identification of motor delay and can make the appropriate referral based on TGMD-2 performance.

Keywords: assessment; motor; impairment; children; program evaluation

Introduction

Motor competence is based on the proficiency level of one's motor abilities and motor skills. Motor competence should be viewed as a continuum with children displaying varying levels of skillfulness in the motor domain. *Motor abilities* are defined as '... general traits or capacities of an individual that underlie the performance of a variety of movement skills' (Burton and Miller 1998, 43). Examples of motor abilities include control precision, multilimb coordination, manual dexterity, and aiming (Fleishman and Quaintance 1984). It has been suggested that motor abilities are relatively stable characteristics that are not easily changed or modified (Schmidt and Lee 2005). However, empirical evidence suggests that motor abilities can be improved with practice (Pless and Carlsson 2000; Sugden and Chambers 2006). Motor skills include fine and gross motor skills. *Fine motor skills* are defined as movements that require mostly smaller muscles or muscle groups of the body (Payne and Isaacs 2008). *Gross motor skills* (i.e. fundamental motor skills [FMS]) are defined as '... motor skills that involve the large, force-producing muscles of the trunk, arms, and legs' (Clark 1994, 245). Gross motor skill performance can be modified through instruction and practice (Robinson and Goodway 2009; Seefeldt 1980; Valentini and Rudisill 2004a, 2004b). Motor competence is needed for individuals to independently engage in their surrounding environment (Clark 2007), and is consistently associated with positive health-related outcomes (Barnett et al. 2011; D'Hondt et al. 2009; Hands 2008; Lopes et al. 2011; Lubans et al. 2010). Despite the various terms used in the literature to describe general and specific aspects of the motor domain (i.e. competence, abilities, skills), it is imperative that clinicians, practitioners, and researchers accurately assess performance in the motor domain.

The Test of Gross Motor Development-2 (TGMD-2) is a validated, criterion- and norm-referenced process-oriented assessment that was designed to qualitatively evaluate gross motor skill performance of children between the ages of three and ten years (Ulrich 2000). The TGMD-2 manual uses Clark's (1994) previously stated definition of gross motor skills. Specifically, the manual states that '... locomotion and object control behaviors form the nucleus of the general domain measured by the TGMD-2' (Ulrich 2000, 1). The assessment examines the performance of 12 FMS that are comprised within two subscales: object control and locomotor. Object control skills include throwing, catching, striking, kicking, dribbling, and underhand rolling. Locomotor skills include running, sliding, galloping, jumping, hopping, and leaping. Each skill is evaluated based on three to five performance criteria. The TGMD-2 has been used to assess gross motor skill development in typically developing preschoolers (Hardy et al. 2010; Robinson and Goodway 2009), school-age children (Houwen, Hartman, and Visscher 2009; Morgan et al. 2008), and children at-risk or diagnosed with developmental delay in the motor domain (Goodway and Branta 2003; Martin, Rudisill, and Hastie 2009; Valentini and Rudisill 2004a, 2004b).

In contrast, the Movement Assessment Battery for Children-2 (MABC-2) is a validated, norm-referenced, and product-oriented assessment that quantitatively evaluates motor competence in children between the ages of three to sixteen years (Henderson, Sugden, and Barnett 2007). The MABC-2 manual states it '... provides objective, quantitative data

on movement competence' through the completion of motor tasks (Henderson, Sugden, and Barnett 2007, 4). Quantitative scoring is based on the number of successful trials completed or the amount of time needed to complete a task. The MABC-2 includes three subscales: manual dexterity, aiming and catching, and balance. The tasks included in these subscales are closely aligned with motor abilities as defined by Fleishman and Quaintance (1984). The MABC-2 has been used in a wide range of populations that includes typically developing preschoolers (Fisher et al. 2005; Logan and Getchell 2010), school-age children (D'Hondt et al. 2009; Haga 2008), and at-risk children (Smits-Engelsman, Henderson, and Michels 1998).

Several researchers in the field of motor development suggest that motor competence is a prerequisite to participation in physical activity (Clark and Metcalfe 2002; Seefeldt 1980; Stodden et al. 2008). The assumption of this relationship is at the '... heart of our physical education programs' and thus warrants investigation (Clark 2005, 44). Researchers have used the MABC-2 (Fisher et al. 2005; Ziviani, Poulsen, and Hansen 2009) and the TGMD-2 (Cliff et al. 2009; Houwen, Hartman, and Visscher 2009) to examine the relationship between motor competence and physical activity. Ziviani, Poulsen, and Hansen (2009) found weak to no relationships between performance on subscales of the MABC (first edition) to physical activity participation and questioned '... the magnitude of the relationship between FMS and physical activity' and emphasized '... the need to move away from skills-based programs to community, occupationally based and cross-disciplinary approaches to enhancing children's engagement in physical activities' (p. 264). However, Cliff et al. (2009) found moderate and significant correlations between TGMD (first edition) performance and physical activity participation. Thus, it is important to empirically determine if the TGMD-2 and MABC-2 are measuring different aspects of the motor domain to fully understand the relationship between motor competence and physical activity.

Another debate centers around the differences between process- and product-oriented approaches to measuring motor competence and whether movement should be evaluated on a developmental continuum (Stodden et al. 2008). The TGMD-2 and the MABC-2 are reliable and validated instruments that assess some aspect of motor competence in children. However, the qualitative and quantitative analysis of movement provides different information. For example, one criterion of throwing on the TGMD-2 is whether or not weight is transferred by stepping with the opposite foot of the throwing arm. Weight transfer is required for a more skillful throw. The throwing task of the MABC-2 instructs children to toss a beanbag to a target mat while children stand 180 cm from the target. Ten trials are performed and success or failure is based on if the beanbag makes contact with the target mat and if children maintain contact with the mat they are standing on. The manual states that an underarm toss should be encouraged while stepping is discouraged; which is a rudimentary movement pattern based on the task constraints. Each assessment does not necessarily claim to measure the same aspects of movement; however, researchers often use each assessment in an attempt to answer similar research questions (i.e. the relationship between motor competence and physical activity). Thus, there is a need to determine how performances between the assessments are related.

From a practical perspective, physical education teachers often incorporate motor assessments into their program for a variety of reasons. The administration of a motor assessment at the beginning and end of the school year can provide valuable information with regard to student improvement. These assessments are an important tool for program evaluation. Also, physical education teachers may choose to examine how different teaching styles or class structures influence motor performance. Thus, motor assessments may shape pedagogical decisions as it relates to student learning. A potential goal

of motor assessments may be to identify children who are delayed in the motor domain. This information may help physical education teachers become aware of student characteristics, design developmentally appropriate lessons, and make recommendations for further testing by an occupational therapist. Another goal may be to specifically assess performance on gross motor skills. The purpose of the motor assessment should be considered when choosing an assessment to use. Therefore, it is essential to compare performances on different motor assessments to provide empirical evidence on how they are related and not related to each other, thereby enabling individuals to administer the assessment that most closely aligns with the purpose of administration.

With these current debates related to the different tasks and method each assessment uses to measure motor competence, there is a need for further investigation. The MABC-2 and TGMD-2 manuals each explicitly provide the same four purposes for assessment. The MABC-2 manual states its purposes include: identification of mild-to-moderate movement difficulties (i.e. Developmental Coordination Disorder), clinical exploration and intervention planning, program evaluation, and as a research tool (Henderson, Sugden, and Barnett 2007). The TGMD-2 manual states its purposes as: identification and screening, assessment of an individual's progress, program evaluation, and as a research tool (Ulrich 2000). Thus, comparison between performances on these two specific assessments is justified and needed. The global question of interest is whether or not the TGMD-2 and MABC-2 measure the same construct of motor competence. Therefore, the purpose of the present study was to: (a) compare the performances of children on the TGMD-2 and the MABC-2, (b) examine if sex and/or age performance differences exist, and (c) determine the level of agreement between the TGMD-2 and the MABC-2 in classifying children as at-risk of Developmental Coordination Disorder and/or developmental delay.

Method

Setting and participants

Sixty-five children (32 boys and 33 girls) enrolled in a public elementary school in the southeast region of the United States participated in the study. The sample included children enrolled in kindergarten ($n = 20$, 10 boys, 10 girls, mean age = 5.7 ± 0.38 years), first grade ($n = 22$, 13 boys, 9 girls, $M = 6.7 \pm 0.34$ years), and second grade ($n = 23$, 9 males, 14 females, $M = 7.8 \pm 0.46$ years). The majority (72.3%) of the children were African-American, while 20% were Hispanic, and 7.7% were Caucasian.

Motor skill assessments

Participants completed the TGMD-2 (Ulrich 2000). The TGMD-2 assesses 12 motor skills separated into two subscales: object control (striking, throwing, catching, kicking, dribbling, and underhand rolling a ball) and locomotor skills (running, galloping, sliding, leaping, hopping, and jumping). A researcher demonstrated the skill and exhibited all behavioral components. Children completed one practice and two formal trials. All trials of the TGMD-2 were videotaped and coding was conducted through video analysis. Two researchers with prior training and experience in analyzing TGMD-2 performance coded all of the data. Inter- and intra-rater reliability was established ($>90\%$ agreement). Each skill was evaluated on three to five performance criteria. A score of zero was given for each trial if a criterion was not performed. A score of one was given for each trial if a criterion was performed. The locomotor subscale yields a raw score that was converted to an

age-specific standard and percentile score. The object control subscale yields a raw score that was converted to an age- and sex-specific standard and percentile score. The standard scores from both subscales were summed and converted to a total standard and percentile score that indicated overall performance on the TGMD-2.

The administration of each subscale of the TGMD-2 occurred separately due to a limited amount of available space. During each session of data collection, approximately three to five children were assessed on a subscale. Children completed one subscale per day on non-consecutive days. There were three trained researchers, one faculty and two graduate students in the area of Motor Behavior who administered the TGMD-2. Each researcher had prior experience in administering the TGMD-2 in both research and practical settings.

Participants also completed the MABC-2 (Henderson, Sugden, and Barnett 2007). There are three age bands which have specific scoring and task variations; Age band 1 (3–6 years old), Age band 2 (7–10 years old), and Age band 3 (11–16 years old). The tasks of Age bands 1 and 2 were used for the present study, dependent upon the age of the child being tested. The MABC-2 is separated into three subscales: manual dexterity (three tasks), aiming and catching (two tasks), and balance (three tasks). The manual dexterity tasks of Age band 1 include placing coins in a box, threading beads on a string, and drawing a line in a specified pattern. The aiming task requires a child to toss a beanbag to a target mat located 180 centimeters away from the child. The catching task requires the child to catch a beanbag. Balance tasks include walking with heels raised in a straight line, balancing on one leg, and performing five consecutive jumps. The manual dexterity tasks of Age band 2 include placing pegs into a board, threading lace, and drawing a line in a specified pattern. For 7- and 8-year old children, the catching task requires a tennis ball to be tossed to a wall, bounce once, then caught with the hands only. For 9- and 10-year old children, a tennis ball is tossed to a wall and immediately caught with the hands only. The aiming task of Age band 2 is similar to that of Age band 2, except the target is smaller. Balance tasks include one-leg balance on a 'balance board', walking heel-to-toe in a straight line, and performing five consecutive hops. More information can be found in the MABC-2 manual (Henderson, Sugden, and Barnett 2007) regarding descriptions and scoring procedures for tasks of Age bands 1 and 2.

The administration of the MABC-2 was divided into four stations: two stations for manual dexterity, one station for aiming and catching, and one station for balance. During each session of data collection, approximately six to eight children were divided among the four stations. Children rotated from station to station, with the aid of research assistants, until the entire MABC-2 was completed. There were six trained researchers, three faculty members and three graduate students in the area of Motor Behavior who administered the MABC-2. Each researcher had prior experience in administering motor assessments in both research and practical settings. One to two researchers were assigned to each station to ensure accurate scoring of the tasks. All researchers attended a 2 h training session to become familiar with the assessment procedures. Scoring was based on quantitative measures such as the number of successful trials and the length of time taken to complete a task. For each subscale, raw scores were converted to age-specific standard scores. Standard scores for each subscale were summed and converted to an age-specific standard and percentile score for total performance on the MABC-2.

Procedure and statistical analyses

This study was approved by the university's human subject review board. Parental consent and child assent was obtained prior to data collection. All children completed the TGMD-2

and the MABC-2 in accordance with the administrative manual for both assessments in a designated space at the elementary school. Each child completed the object control subscale of the TGMD-2, the locomotor subscale of the TGMD-2, and the MABC-2 assessment on three non-consecutive days to avoid fatigue or loss of attention that could influence performance. Pearson correlations were calculated between standard scores for each subscale and total performance on each assessment and evaluated using a two-tailed hypothesis at $\alpha = 0.05$ (Thomas, Nelson, and Silverman 2005). A 2 (sex) $\times$ 3 (grade) MANOVA was conducted to determine if sex and/or grade-level differences were present on the standard score of each assessment. A paired-samples *t*-test was calculated between percentile scores to determine if differences exist between total performances on each assessment. Percentile scores were used for this analysis because each assessment has a different scale for standard scores. Thus, comparisons between standard scores were not appropriate. A crosstab analysis of percentile scores for total performance on each assessment was conducted to determine the level of agreement between the assessments to classify children as at-risk. The use of standard scores to examine age and sex differences and percentiles to determine agreement between assessments is appropriate based on previous research (Getchell et al. 2007; Smits-Engelsman, Henderson, and Michels, 1998; Waelvelde et al. 2007). SPSS version 17.0.1 for Windows was used for data analyses.

Results

See Table 1 for participants' mean standard scores for each subscale and total performance on the TGMD-2 and the MABC-2, respectively. See Table 2 for Pearson correlations of standard scores on each subscale and total performance of the TGMD-2 and the MABC-2. The significant correlations ranged from 0.27 to 0.52. The range of r^2 values of significant correlations was 0.07 to 0.27. This indicated that at most, 27% of the variance was explained by any correlation. The strongest correlation of 0.52 and the highest r^2 value of 0.27 were between total performances of the TGMD-2 and MABC-2. While the two assessments demonstrated a significant positive relationship, r^2 values are of low practical significance. A paired samples *t*-test revealed a significant difference between the mean percentiles of total performance on the TGMD-2 and MABC-2 ($t(64) = 7.8, p < 0.01$). Participants scored higher on the MABC-2 (mean percentile = 42.2, SD = 29.2) compared to the TGMD-2 (mean percentile = 17.2, SD = 13.3). A 2 (sex) $\times$ 3 (grade) MANOVA revealed no significant sex differences on total performance of the TGMD-2 ($F = 0.85, p = 0.36$) or the MABC-2 ($F = 0.2, p = 0.66$), indicating that boys and girls performed similarly on each assessment. Results also revealed no significant differences on total

Table 1. Standard scores for performance of each subscale and total performance on the TGMD-2 and MABC-2.

Group	<i>n</i>	Object control	Locomotor	TGMD-2	Manual dexterity	Aim and catch	Balance	MABC-2
Boys	32	8.7 (1.9)	5.7 (2.1)	82.9 (9.4)	7.8 (3.1)	10.8 (3.7)	9.6 (2.8)	9.2 (3.2)
Girls	33	8.8 (2)	5.9 (1.8)	84 (8.8)	8.3 (2.8)	10 (2.6)	10.1 (2.8)	9.3 (2.8)
<i>K</i>	30	9 (1.9)	6.1 (1.4)	85 (6.9)	7.3 (3.2)	10.3 (2.9)	9.6 (2.5)	8.9 (3.1)
First grade	22	9.2 (1.7)	6.2 (1.9)	86.2 (8.6)	8.9 (2.8)	11 (3.2)	10.5 (2.8)	10 (2.7)
Second grade	23	8 (2.2)	5.1 (2.3)	79.5 (10.1)	7.9 (2.7)	10 (3.5)	9.5 (3.1)	8.8 (3.1)
All	65	8.7 (2)	5.8 (2)	83.5 (9.1)	8 (2.9)	10.4 (3.2)	9.9 (2.8)	9.2 (3)

Table 2. Pearson correlations between standard scores for each subscale and total performance on each motor assessment.

	MABC-2							
	Total		Manual dexterity		Aim and catch		Balance	
	<i>r</i>	<i>r</i> ²	<i>r</i>	<i>r</i> ²	<i>R</i>	<i>r</i> ²	<i>r</i>	<i>r</i> ²
TGMD-2								
Total	0.52**	0.27	0.34**	0.12	0.38**	0.14	0.41**	0.17
Object control	0.41**	0.17	0.36**	0.13	0.32**	0.1	0.22	0.05
Locomotor	0.39**	0.15	0.16	0.03	0.27*	0.07	0.42**	0.18

Note: Total = total performance on each respective assessment.

*The correlation is significant at an α level of 0.05.

**Significance at the 0.01 level.

performance on the MABC-2 ($F = 0.93$, $p = 0.4$) based on the grade level. However, a grade difference was found on the TGMD-2 ($F = 4.3$, $p = 0.02$, $\eta^2 = 0.128$). Tukey's post hoc analysis revealed a significantly higher TGMD-2 performance for first graders compared to second graders ($p = 0.03$), but no difference compared to kindergarteners ($p > 0.05$). No significant interaction effect was found for either assessment ($p > 0.05$). Results of Levene's test indicated that the assumption of equal variances was not violated for TGMD-2 percentile ($F = 0.85$, $p = 0.52$) or MABC-2 percentile ($F = 0.72$, $p = 0.61$).

The MABC-2 manual recommends that children who score at or below the 15th percentile are at-risk of Developmental Coordination Disorder. Also, federal guidelines suggest that children who score at or below the 30th percentile on a motor assessment are delayed (Individuals with Disabilities Education Improvement Act of 2004, 2004). To determine the level of agreement between each assessment to identify children as at-risk of Developmental Coordination Disorder or delayed, crosstab analyses were calculated based on the 15th and 30th percentile criterion. Results indicate that both assessments agreed on 9 out of 11 possible children as at-risk of Developmental Coordination Disorder (below the 15th percentile; 81.8% agreement) and 27 out of 29 children as delayed (below the 30th percentile; 93.1% agreement).

Discussion

The results of the study indicated that the TGMD-2 and MABC-2 measure different aspects and/or levels of motor competence. Although 10 of 12 possible correlations were significant when the subscales and total performance on each assessment were compared, the range of r^2 values (0.07–0.27) indicates weak practical significance. In this sample of children, mean performance on the TGMD-2 was significantly lower (17th percentile) compared to the MABC-2 (42nd percentile). This result suggests that children in this study were typically developing with regard to motor competence as measured by MABC-2 performance. However, performance on the TGMD-2 suggests lower motor competence and a delay of gross motor skill development. This delay is likely due to a lack of opportunities to develop specific skills through quality physical education classes or structured movement programs. Children attended a rural, low socioeconomic school and it is possible that families do not have access to the resources to allow their children to participate in organized sports and physical activity. One possible explanation for the performance difference found between assessments is the different tasks of age band one and two for the MABC-2.

Although similar, the tasks for each subscale are slightly modified for each age band. For the TGMD-2, the same skills are assessed for children of all ages, although performance is scored differently based on age and sex.

The TGMD-2 and MABC-2 assess different skills in different ways (i.e. object control skills vs. manual dexterity), but also similar skills in different ways (i.e. catch, jump). Thus, the global construct of motor competence may manifest at different levels due to the sensitivity and discriminating capability of these two assessments, as well as the type of scoring used (product vs. process). It is possible that performance was lower on the TGMD-2 compared to the MABC-2 because the skills of the TGMD-2 simply demand more advanced levels of coordination and control that are a function of practice/experience. Thus, it may be 'easier' for children to score well on the MABC-2, but the TGMD-2 may be more sensitive at classifying children as highly skilled, at least in this sample of school-aged children.

Results also indicate that there were no differences in performance on each assessment with regard to sex. However, previous research has found that boys score higher on ball tasks and girls score higher on the manual dexterity tasks of the MABC (Junaid and Fellowes 2006). It is interesting that first-grade children scored higher on the TGMD-2 compared to second grade children. Although significant, the effect size estimate of the higher performance for first grade students indicated a weak effect ($\eta^2 = 0.128$). One possibility for this finding is the scoring guidelines of the TGMD-2. Children in the first grade are typically 6–7 years old. Raw scores are converted to standard scores based on 6-month increments in age until a child is 8 years old. Thus, raw scores of a child 6 years and 5 months old or younger receive a different standard score than a child that is 6 years and 6 months old or older. Children in the second grade are typically 7–8 years old. At age 8, standard scores are based on whole-year increments. For the present sample, it is possible that children did not continue to improve in gross motor skills from first to second grade or what appeared to be a higher performance in first grade becomes a lower performance in second grade due to the conversion of raw scores to standard scores.

To our knowledge, only one previous study has compared performances between the TGMD-2 and MABC-2 in a sample of typically developing children (Logan, Robinson, and Getchell 2011). In preschool children, results indicated similar total performance on the TGMD-2 (mean percentile = 35.7) and MABC-2 (mean percentile = 31.7) assessments. This result is not consistent with the present study which indicated different levels of performance on each assessment for kindergarten through second-grade children. It's possible that the assessments become more capable of discriminating levels of motor competence as children age. As children participate in physical education programs and structured movement programs and receive instruction regarding technique of gross motor skills, performance in these skills is expected to increase (Logan et al., 2011). Also, a correlation analysis indicated that 24% of the variance was explained by total performance on each assessment. This result is very similar to the present study that reported 27% of explained variance by total performance on each assessment. Thus, the findings of these two studies indicate that performance on the TGMD-2 and MABC-2 may be related, however not to a large degree.

We suggest that the MABC-2 assesses motor abilities, which is a specific aspect of motor competence. For example, the manual dexterity tasks include placing coins in a box and threading beads on string as quickly as possible. Scoring is based on the time needed to complete the task. In addition to fine motor skill, these tasks require speed, accuracy, timing, coordination, and depth perception to complete each task in a timely manner. Several of these abilities are required to successfully execute skills that involve projecting,

receiving, and intercepting objects. The MABC-2 also assesses balance through one static and two dynamic tasks. Balance requires a degree of muscular strength to adequately stabilize and control the body. The ability to balance is at least partly attributed to the development of the vestibular system and the cerebellum (Angelaki and Cullen 2008). The performance of many locomotor skills such as hopping, jumping, and galloping all requires coordination and balance. Thus, tasks of the MABC-2 measure motor abilities that are the building blocks of complex movements such as gross motor skills. The MABC-2 is commonly used to screen children for mild motor impairment and Developmental Coordination Disorder which is suggested to be caused by underlying neurological causes, as evidenced by the comorbidity of Developmental Coordination Disorder with language, attention, and other learning disorders (Getchell, Logan, and Neeld 2009).

We suggest that the TGMD-2 is an assessment of gross motor skills. Gross motor skills need to be learned and do not develop 'naturally' with age (Clark 2005). If a child does not exhibit the necessary muscular strength, balance, and perceptual/visual abilities associated with typical development, it is unlikely that the child will successfully execute gross motor skills such as jumping, hopping, and catching, even if the child has been instructed on the correct technical aspects of these skills. If a child scores low on the TGMD-2, indicating a lack of gross motor skills, then low performance on the MABC-2 should be expected. Our results support this expectation as indicated by the high level of agreement of low motor performance by both assessments. Perhaps the TGMD-2 and MABC-2 can be used to compliment to each other. We suggest it is very important for clinicians, practitioners, and researchers to choose an appropriate assessment based on the purpose of measurement.

The TGMD-2 and MABC-2 should not be used interchangeably to describe motor competence. Each assessment measures a different aspect of motor competence and may be sensitive to measure varying levels of motor competence. The lower performance on the TGMD-2 compared to the MABC-2 in the present sample suggests that the TGMD-2 may be a more appropriate measurement tool to discriminate levels of motor competence. Thus, we suggest that the TGMD-2 may be a better assessment to examine the relationship between motor competence and physical activity. This is suggested based on the type of skills assessed by the TGMD-2 (i.e. object control and locomotor skills) and the greater discriminatory nature of this assessment.

The findings indicate that each assessment may be used to screen for motor delay of varying degrees. According to the 15% or below criterion, each assessment agreed on 81.8% of cases to identify children as at-risk of Developmental Coordination Disorder. To further examine the level of agreement to identify motor impairment, we extended the cut-off score to the 30th percentile, as suggested by federal guidelines for the identification of developmental delays (Individuals with Disabilities Education Improvement Act of 2004, 2004). Using this criterion, each assessment agreed on 93.1% of cases.

Given the level of agreement between the TGMD-2 and the MABC-2 to identify children as at-risk of Developmental Coordination Disorder and developmentally delayed in the motor domain, it may be recommended that physical education teachers administer the TGMD-2 as part of annual or bi-annual assessment. Physical education teachers can act as the first line of defense in early identification of motor impairments and can make the appropriate referral based on TGMD-2 performance. Thus, using a similar guideline proposed by the MABC-2 manual, children scoring at or below the 15th percentile may be referred to a specialist as a precautionary measure. We are not suggesting that physical education teachers are qualified to make medical diagnoses, simply that referral may be appropriate. There are two advantages to the use of the TGMD-2 in physical education

settings. The TGMD-2 specifically measures gross motor *skill* competence, which is more relevant to physical education class and pre- and post-testing may provide valuable information toward teaching effectiveness and curriculum development. In addition, group testing is possible through video analysis. The administration of the MABC-2 requires individual testing and may not be possible for physical education teachers due to a lack of assistance and additional resources. Finally, physical education teachers are most likely experienced and trained in identifying the presence or absence of behavioral characteristics of motor skill performance. The MABC-2 requires specific training and physical education teachers may not have the time or resources to become adequately trained.

We acknowledge that some limitations are present in this study. The sample was homogenous since 72.3% of children are African-American. Thus, generalization to other populations is not appropriate. However, to the authors' knowledge, this was the only the second study to compare motor performances of the TGMD-2 and the MABC-2. But, future research should continue to examine the relationship between performances of motor assessments in more children of varying ages and across diverse populations. Another limitation is that medical records were not obtained to determine which children were formally diagnosed as at-risk of developmental delay in the motor domain. More research is needed to examine how performances on motor assessments are related. This information is valuable to researchers in order to fully understand overall motor development. Furthermore, this information is important for physical education teachers as it relates to motor screening, student improvement, and pedagogical decisions.

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