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Original Article

Assessment of motor competence in Indonesian elementary school children using the Körperkoordinationstest Für Kinder (KTK3+) (Body coordination test for children)

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Abstract
Motor competence plays a pivotal role in the development of physical, cognitive, and social skills in school-aged children. Despite its significance, there is a notable gap in research on the motor competence of elementary school children in Indonesia, and in particular the application of the modified Körperkoordinationstest Für Kinder (KTK3+). Widely recognized for its efficacy, cost-effectiveness, and user-friendly nature, the KTK3+ test battery has proved to be a valuable tool for evaluating motor competence in children in various nations. It comprehensively assesses gross motor skills, including balance, object control, and locomotion. In this study, the first of its kind in Indonesia, we evaluated 243 elementary school children (n = 182 rural, n = 61 urban) from West Sumatra, Indonesia, aged 7-12 years and comprising 123 boys and 120 girls. All children performed four subtests: balance beam (BB), moving sideways (MS), jumping sideways (JS), and eye-hand coordination (EHC). Multivariate analysis of variance (MANOVA) for motor scores revealed statistically significant effects based on location and age ($p < .05$). On average, older children exhibited superior performance compared to their peers who were one year younger, with the most substantial increase observed in the age groups of 10, 11, and 12 (mean raw scores, $p < .05$). However, the study findings suggest a less consistent improvement in motor performance among 7–9-year-olds. Additionally, rural children outperformed their urban counterparts across all test protocols and motor quotients (MQ). Notably, girls excelled in JS, while boys demonstrated superior performance in BB, MS, and EHC. Motor quotient scores indicated that 36% of the children fell within a range of motor competence that could be classified as impaired. The outcomes underscore the utility of the KTK3+ as an effective tool for assessing individual motor competence among Indonesian children. The use of this tool in elementary schools is recommended for assessment purposes and for addressing the challenges associated with an observed decline in coordination skills. The KTK3+ test can provide valuable insights that will help to enhance policies that support physical activity, sports, and physical education for children and adolescents.
Keywords: motor competence, coordination, KTK3+, motor proficiency, test battery, children

Introduction

Motor competence (MCn) refers to proficiency in various motor skills, including the motor control and coordination that is required in daily tasks (Coppens et al., 2021; Utesch et al., 2019). MCn is an essential aspect of development (Adolph & Hoch, 2019) and a predictor of physical activity in childhood (Eldiasty et al., 2023; Lopes et al., 2011; Wälti et al., 2022), since it is associated with an increase children's participation in games, play and other physical activities (PA) such as running, throwing, kicking, hitting, walking, jumping, catching, and rolling (Coppens et al., 2021). The elementary school age (6 to 12 years) is an important period during which basic MCn and physical skills are develop rapidly into more complex skills (maturation), which can be applied to sports and cultural activities (Draghi et al., 2021; Gallahue et al., 2012; Mark De Niet, Wetzels, Pion, Faber, Platvoet, & Elferink-Gemser, 2022). At this stage, children are interested in various types of sports and do not feel confined by physiological, anatomical, or environmental factors (Derikx et al., 2021; Gallahue et al., 2012). Many factors can affect the ability of children to improve their skills, and one of them is the maturation factor. The maturation factor can influence growth, performance, PA and physical fitness (Eisenmann et al., 2020; Malina & Kozieł, 2014). However, skills are influenced not only by maturation effects but also by genetic potential, as well as cultural, social, and environmental factors (Clark & Metcalfe, 2002; Draghi et al., 2021; Venetsanou & Kambas, 2010). It is essential to consider these various influences to fully understand the development of physical skills.

School is an optimal environment and the best place for children to spend most of their time and develop their motor skills (Reif et al., 2021). Hence, schools should provide appropriate pedagogical guidance and resources to support their physical development according to their age group (Draghi et al., 2021;

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Venetsanou & Kambas, 2010). In this context, physical education (PE) teachers must be able to think more creatively and comprehensively in developing an enjoyable and effective learning environment in order to increase children's motivation in PA for recreation, for sports and for the development of broad motor skills (Caçola & Lage, 2019).

PE teachers are qualified professionals who are able to develop a child's motor skills and sport potential in a structured environment (Niet et al., 2022; Platvoet et al., 2015). Therefore, holistically building physical development by promoting school-age children's motor skills through physical education and recreational activities is very important for the broader development of the child (Draghi et al., 2021; Oya et al., 2023; Susaki, 2021). Nevertheless, there still needs to be a greater understanding of how to develop practices that can improve the MCn abilities of school-age children (Platvoet et al., 2016). In many American and European countries, physical education is quite stable compared to Asian countries (Yan Ho et al., 2019). In contrast, the competence of PE teachers in Indonesia still needs to improve with respect to pedagogic, professional, and personality characteristics (Sudarso et al., 2019).

In addition to the need to improve the capabilities of physical education teachers in Indonesia, there are still few physical education teachers who know the instruments for evaluating the motor competence of their students. Several test instruments have been used worldwide to assess motor competency skills in children, including the Test of Gross Motor Development–Third Edition (TGMD-3) (Famelia et al., 2018; Ulrich, 2019; Wagner et al., 2017); Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) (Bruininks & Bruininks, 2006; Prvulović et al., 2022); Movement Assessment Battery for Children (MABC-2) (Henderson & Barnett, 2007; Jaikaew & Satiansukpong, 2019); and the Körperkoordinationstest für Kinder (KTK) (Kiphard & Schilling, 2007). Of these, the KTK is one of the most commonly used (Bardid et al., 2015; Moreira et al., 2019; S. Platvoet et al., 2018). It was developed in Germany for testing children and adolescents from the ages of 5 to 14 (Kiphard & Schilling, 1974, 2007). Based on the literature, it can be seen that the KTK has been widely used in countries throughout the world, including Australia (Bardid et al., 2015), Europe (Laukkanen et al., 2020), Brazil (Moreira et al., 2019), the United States (Campbell-Pierre & Rhea, 2023), China (Li et al., 2023), and Indonesia (Adriyani et al., 2019). Recently, the original KTK has been modified to KTK3+ (Niet et al., 2021) to avoid potential risks of injury and the duration of the test (Biino et al., 2022).

In recent years, the popularity of KTK3+ has increased among PE teachers, since it is relatively easy to use in the evaluation of MCn (Coppens et al., 2021; Platvoet et al., 2018). The modified KTK3+ changed hopping for height (HH) (Novak et al., 2017) with the task of eye-hand coordination control objects to assess all three fundamental motor skills (FMS) categories, such as balance, locomotion, and object control (Platvoet et al., 2018). Therefore, KTK without HH can be applied to educational and sporting settings. In addition, the KTK3+ demonstrated strong test-retest reliability in all subtests: JS at 0.95, MS at 0.84, EHC 0.87, and BB 0.80 (Faber et al., 2014; Platvoet et al., 2018).

More importantly, KTK3+ has become part of the process of talent detection and identification of athletes (Mostaert et al., 2016; Mireille Mostaert et al., 2021; Pion et al., 2015; Robertson et al., 2022; Rozilee et al., 2019; Tribolet et al., 2018; Vandorpe et al., 2011). Robertson et al. (2022) demonstrated a significant relationship between the results of the KTK3+ and the coach's decisions in the crucial stages of identifying, selecting, and evaluating the development of young athletes in badminton. This is in line with the result of Mostaert et al. (2022), who explained that KTK3+ is a test battery that contributes significantly (U-15 cycling athletes resulting in a 4.7% higher chance of appearing in high-level matches 2-3 years later) to the future athletes' success.

A recent study showed significant differences in the development of motor competence in individual children (Bakhtiar, 2014; Coppens et al., 2019). The PE teacher's limited understanding of these individual developmental differences reduces the benefits of using group references (Niet et al., 2022). Therefore, individual data on MCn proficiency will be more beneficial to PE teachers than average proficiency in a grade or age group (Opstoel et al., 2022). Several factors related to individual development are age and gender (Niet et al., 2022; Platvoet et al., 2016; Vandorpe et al., 2011). Research has shown gender differences in MCn abilities, where boys are better than girls on object control tasks, and girls are better than boys on balancing tasks (Bolger et al., 2018; Famelia et al., 2018; Platvoet et al., 2018). Boys usually spend more time outdoors with their friends at school and after school, giving them more experience with object control (Famelia et al., 2018). Another study found that girls have superior fundamental motor skills (FMS) compared to boys (Cinar et al., 2023). However, other studies have found no significant gender differences in MCn (Platvoet et al., 2020; Platvoet et al., 2016; Rodrigues et al., 2016). These discrepancies in the literature suggest that PE teachers need to review individual profiles to develop proficiency in MCn.

As stated, MCn data on individual children in Indonesian elementary schools using KTK3+ is still unavailable. A pilot study is needed to inform larger-scale research. Thus, the aim of the present study was to evaluate the MCn of Indonesian boys and girls between 7- to 12-year-olds using the modified KTK3+. We expected girls to perform better on BB and boys to perform better on EHC. Furthermore, we hypothesized that older children would be better than their younger counterparts year after year. A secondary aim was to compare the raw score and MQ value of Indonesian elementary schools in rural and urban areas.

Materials and Methods

Participants

A total of 243 elementary school children (n= 182 rural, n= 61 urban), comprising 123 boys and 120 girls between the ages of 7 and 12 years in West Sumatra, Indonesia. West Sumatra is one of 38 provinces in Indonesia and is also undergoing experiencing significant urbanization. Written informed consent was obtained from the parents or guardians of each participant. The study was approved by the Universitas Negeri Padang (2031/UN35.3/LT/2022) and the local Ethics Committee (450/300/DIKBUD/2022). The measurements were conducted from April 2022 to May 2022. All testing was conducted by qualified testers (PE teachers and sport science students) outdoors on selected days for all selected schools. During the test, children were barefoot and wearing light sports clothing.

Measurements

Anthropometric measurements were conducted using standard protocols. Height was measured using a microtoise/stadiometer with an accuracy of 0.1 cm (Kusuma & Rosidi, 2018; Rumapea et al., 2021), and weight was measured using a bioelectrical impedance device with an accuracy of 0.1 kg (Tanita, BC-730). Children's body mass index (BMI) was calculated using the standard formula (weight/height²).

To evaluate MCn, participants need to complete four KTK3+ items: balance beam (BB, a total of nine attempts with three attempts on three different-sized beams (6 cm; 4.5 cm and 3 cm), the score being the total number of steps with a maximum of 72) (ICC= 0.80); jumping sideways (JS, jumping with two legs sideways on a wooden bar two attempts of 15 seconds, the score being the total number of sideway jumps) (ICC= 0.95); moving sideways (MS, two attempts of 20 seconds each, the score being a total number of sideway moves) (ICC= 0.84); and an eye-hand coordination (EHC, two attempts of 30 seconds each, the score being the total number of catches) (ICC= 0.87) (Platvoet et al., 2018).

Data Analysis

All analyses were performed using SPSS Statistics 27, and a value of $p \leq 0.05$ was considered statistically significant. First, we investigated whether differences in gender, age, and motor quotient categories were similar for both the rural and urban samples. Second, the differences were analysed using three different (rural vs. urban) x 2 (sex) x 6 (age groups: 7-8-9-10-11-12 years) MANOVAs for the motor coordination measurements, respectively. The magnitude of the difference between the groups was estimated using a partial squared eta (ηp^2) with cut-off scores of 0.01 (small), 0.06 (moderate), and 0.14 (large).

Additionally, we provide conversion tables and raw scores collected during our research. The standard scores for boys and girls on KTK3+ are summed and converted to a total Motor Quotient (MQ). Thus, for each age, sex, gender, and test item, separate means and standard deviations are calculated using the following formula:

$$Z - Score_{test} = \frac{raw\ score_{test} - Mean_{test}}{standart\ deviation_{test}}$$

The MQ score is then derived from the z-score for each KTK3+ test score, with the following formula, following the example of Pion (2015):

$$MQ_{test} = 100 + (z - score_{test} \times 15)$$

For the total KTK3+ score, MQ can be divided into five different MC levels based on the standard normal distribution (Vandorpe et al., 2011). A score below 70 is considered to be indicative of "severe MCn impairment", a score between 71 and 85 is considered to represent "moderate MCn impairment", a score between 86 and 115 is considered "normal MCn ability", and an MQ-score between 116 and 130 constitutes "good MCn proficiency," while scores above 131 indicate "high MCn proficiency."

Results

Rural and Urban Children's raw score Differences

Means and standard deviations for all subtests are reported in **Table 2**. The results of the MANOVA are presented in **Table 4.**

Significant multivariate effect were found for age (Wilks' $\lambda = 4.61$; $F = 9.44$; $p < 0.05$; partial $\eta p^2 = 0.176$) and location (Wilks' $\lambda = 0.51$; $F = 51.32$; $p < 0.05$; partial $\eta p^2 = 0.487$). We also found significant multivariate interaction effects for age*gender (Wilks' $\lambda = 0.84$; $F = 1.96$; $p < 0.05$; partial $\eta p^2 = 0.043$) and age*location (Wilks' $\lambda = 0.77$; $F = 2.90$; $p < 0.05$; partial $\eta p^2 = 0.062$). No other significant multivariate effects were found.

Table 1 | Anthropometric classification of children's mean and standard deviation (SD) in different age groups.

Variables	7 years	8 years	9 years	10 years	11 years	12 years
Boys (*n = 123*)						
Weight	28.9 ± 8.2	28.9 ± 9.5	27.3 ± 7.7	27.1 ± 6.1	42.3 ± 12.7	42.2 ± 11.7
Height	129.6 ± 8.6	126 ± 6.8	129.2 ± 9.1	132.7 ± 15.8	149.2 ± 8.2	148 ± 6.5
BMI	17 ± 3.1	17.8 ± 4.1	16.1 ± 3	15.5 ± 2.8	18.8 ± 4.3	19 ± 4.4
Girls (*n = 120*)						
Weight	22.9 ± 6.6	23.3 ± 6	24 ± 5.9	25.5 ± 8.7	29.1 ± 7.8	38.2 ± 10
Height	117 ± 6.6	119.2 ± 7.5	124.3 ± 8.2	124.2 ± 10.2	134 ± 9	144.3 ± 8.2
BMI	16.6 ± 4	16.3 ± 2.8	15.4 ± 2.2	16.1 ± 3.4	16 ± 3	18.1 ± 3.6

In the overall analysis, rural children had better balance beam ($F(1, 219; p < 0.05$; partial $\eta p^2 = 0.163$), jumping sideways ($F(1, 219; p < 0.05$; partial $\eta p^2 = 0.407$), moving sideways ($F(1, 219; p < 0.05$; partial $\eta p^2 = 0.230$), and eye-hand coordination ($F(1, 219; p < 0.05$; partial $\eta p^2 = 0.126$) compared to their urban peers. Additionally, children's motor coordination abilities increased with increasing age in balance beam ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.270$), jumping sideways ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.303$), moving sideways ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.148$), and eye-hand coordination ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.312$). No significant differences were found between the sexes.

Table 2 | Raw scores for each KTK3+ test are indicated by mean and standard deviation (SD), stratified by location and age group.

Variable	7 years mean ± SD	8 years mean ± SD	9 years mean ± SD	10 years mean ± SD	11 years mean ± SD	12 years mean ± SD
Jumping Sideways						
Rural	50 ± 9	62 ± 15	58 ± 10	61 ± 8	64 ± 8	69 ± 9
Urban	26 ± 10	39 ± 9	42 ± 7	47 ± 9	52 ± 8	51 ± 7
Moving Sideways						
Rural	39 ± 6	39 ± 15	44 ± 5	43 ± 6	45 ± 6	45 ± 8
Urban	29 ± 3	29 ± 4	32 ± 6	34 ± 6	38 ± 7	40 ± 5
Balance Beam						
Rural	60 ± 11	61 ± 12	65 ± 10	62 ± 9	66 ± 7	65 ± 7
Urban	42 ± 11	42 ± 14	54 ± 3	61 ± 7	64 ± 5	65 ± 5
Eye hand coordination						
Rural	4 ± 4	12 ± 11	9 ± 7	15 ± 8	17 ± 6	20 ± 7
Urban	4 ± 4	1 ± 2	4 ± 2	6 ± 2	11 ± 3	17 ± 5

Further, univariate interaction effects were found in age*gender in balance beam ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.076$) showing that the abilities of girls and boys increase with increasing age. Other significant interaction effect were also found between age*location in balance beam ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.143$) and eye-hand coordination ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.059$). Finally, significant univariate effect were found between age*gender*location in balance beam ($F(5, 219; p < 0.05$; partial $\eta p^2 = 0.085$). No other significant univariate effects were found.

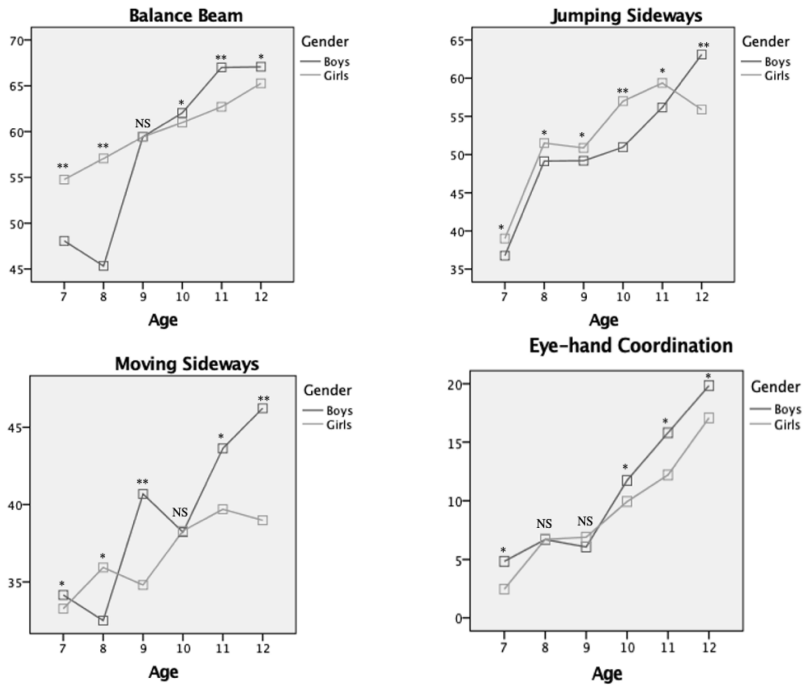

Figure 1. Comparison between the boys and girls samples for the raw score on each KTK3+ (**P<0.001; *P<0.05; NS, non-significant)

Comparing Motor Quotients of Rural and Urban Children

The ANOVA for the total KTK MQ showed a significant location effect ($F = 72.47; p < 0.001$; partial $\eta p^2 = 0.232$). The performance of rural children was higher in comparison with urban children (see **Table 2**). MANOVA for the Motor Quotients of the test showed a significant age (Wilks' $\lambda = 0.46$; $F = 11.13$; $p < 0.001$;

partial $\eta p^2 = 0.177$) and location effect (Wilks' $\lambda = 0.51$; $F = 51.32$; $p < 0.001$; partial $\eta p^2 = 0.487$). Motor Quotient scores of rural children were significantly higher for all subtests ($F = 51.32$; $p < 0.001$; partial $\eta p^2 = 0.487$) in comparison with urban children. The percentages of rural scoring below normal is 3.3% and urban is 31.1% based on the standardization sample.

Table 3 | Classification of motor quotients of overall, gender, age and location categories of children in Indonesia, evaluated by the KTK MQ.

	LEVEL OF MOTOR QUOTIENTS			
	Poor	**Normal**	**Good**	**High**
Overall				
All children (n= 243)	87 (35.8%)	132 (54.3%)	19 (7.8%)	5 (2.1%)
Gender				
Boys (n= 123)	43 (35%)	64 (52%)	11 (8.9%)	5 (4.1%)
Girls (n= 120)	44 (36.7%)	68 (56.7%)	8 (6.7%)	0 (0%)
Age				
7-9 yo (n= 153)	83 (54.2%)	63 (41.2%)	6 (3.9%)	1 (0.7%)
10-12 yo (n= 90)	4 (4.4%)	69 (76.7%)	13 (14.4%)	4 (4.4%)
Location				
Rural (n= 182)	6 (3.3%)	160 (87.9%)	16 (8.8%)	0 (0%)
Urban (n= 61)	19 (31.1%)	42 (68.9%)	0 (0%)	0 (0%)

Frequency and percentage data are used. KTK: *Korperkoordinationstestfur Kinder*; yo: years-old.

Table 3 shows the results of the MQ KTK3+ tests applied to elementary school students in Indonesia and divided by category (gender, age, and location). In the analysis by age, children aged 10 to 12 years performed better than those aged 7 to 9 years for total MQ KTK3+ performance ($p<0.05$; $\eta p^2= 0.177$;*large*). No other significant differences between the age were found. In the analysis by gender, boys performed better than girls in the MQ score of the moving sideways test ($p<0.05$; $\eta p^2= 0.022$;*small*). No other significant differences between the gender were found. In the analysis by location, rural children performed better than urban children for total MQ KTK3+ performance ($p<0.05$; $\eta p^2= 0.487$;*large*). No other significant differences between location were found.

Table 4 | Main and interaction effects on KTK3+ based on location, age, and gender categories.

	BB	**JS**	**MS**	**EHC**
^{F}LOCATIONxAGExGENDER	4.05^{**}	0.99^{*}	1.20^{*}	0.24^{*}
ηp^2	0.085	0.022	0.027	0.006
^{F}LOCATION	42.67^{****}	150.27^{****}	65.53^{****}	31.66^{****}
ηp^2	0.163	0.407	0.230	0.126
^{F}AGE	16.20^{****}	19.02^{****}	7.61^{****}	19.90^{****}
ηp^2	0.270	0.303	0.148	0.312
^{F}GENDER	1.99^{*}	0.348^{*}	4.85^{**}	2.64^{*}
ηp^2	0.009	0.004	0.022	0.12

$^{*}p \geq 0.05$, $^{**}p \leq 0.05$ $^{***}p < 0.01$, $^{****}p < 0.001$

Discussion

This was the first study to evaluate the motor competence of Indonesian boys and girls aged between 7 and 12 years using the modified Körperkoordinationstest für Kinder (KTK3+). We focused on a group of Indonesian children living in both rural and urban areas.

In our sample of Indonesian children, significant increases with age were observed, with each age group scoring significantly better than their peers 1 year younger. This is in line with the study of Coppens et al. (2021), which found a significant increase in motor competence with age. The older age group outperformed their younger counterparts. Moreover, a recent single school-year study by Niet et al. (2022) also showed consistent improvement in all four test items during the elementary school years. Our findings are also consistent with research by Rodrigues et al. (2019), which showed a positive relationship between age and MCn during and after childhood. Based on the "mountain of motor development" model and Coppens et al.'s (2019) findings, we hypothesized that MCn would improve the most in 7- to 9-year-old children. Our study results showed a less stable increase in motor performance between 7 and 9 years but an average improvement in 10 to 12-year-olds. We note that the age between 7 and 9 years is a sensitive period for the development of motor skills (Almeida et al., 2021). Understanding the timing of stability or consistency of motor skills throughout the developmental period of both boys and girls is essential, since it helps in the design of interventions that increase motor skills (Barnett et al., 2010). This is in line with the study of Antunes et al. (2015) for children in Portugal, which found no clear and stable increase in gross motor competence until 9 years. This also highlights that we must critically evaluate Indonesia's current PE curricula. For example, following the mountain of motor development and PE guidelines, physical education classes for 7 to 10-year-olds should focus more on context-specific motor skills

(i.e., sports) to be developed during this period, providing the foundation for later motor skills. Therefore, we strongly recommend a critically review of our PE curricula, prioritizing individual MCn proficiency in activity choices rather than using activities designed for specific age groups.

With regard to gender, overall scores in this study show that statistically, there were no significant differences in gender. These results are supported by Niet et al. (2022), who showed that boys and girls develop similarly at school age (6- to 12-year-olds). However, a more specific analysis of each variable shows that girls are superior in the BB and MS (Platvoet et al., 2018), (Niet et al., 2022), and (Li et al., 2023), while boys are superior in the EHC test (Faber et al., 2017; Platvoet et al., 2018). Based on our study's results, raw scores for the BB test showed that girls outperformed boys in only two age groups (7 and 8 years), while boys outperformed girls in three age groups (10, 11, and 12 years). This result contrasts with the original KTK sample (Kiphard & Schilling, 1974), which found no gender differences on the BB test and did not develop separate reference scores for boys and girls on this item. However, a recent study from Rodríguez-Negro et al. (2021) found that girls were more proficient than boys in balancing tasks at early elementary school age (6- to 8-year-olds). Gender differences in balance skills might be related to children's physical activity habits. Our findings might therefore indicate that boys are more fit than girls. This was also described by Famelia et al. (2018) that boys in Indonesia usually have more opportunities to play outside with their friends after school rather than girls, which potentially provides them with more experience in ball skills such as kicking and throwing. Further research is needed to understand better the causes of differences in MCn aspects between boys and girls over time.

Regarding raw scores on EHC, in our sample, boys caught the ball better than girls at all ages, but the differences were insignificant at ages 8 and 9. Coppens et al. (2021) and Platvoet et al. (2018) both explained that implementing EHC for young children can be challenging. Our study found that children aged 7 to 9 years experienced significant difficulty in coordinating their hands and eyes during the ball-catching test, resulting in many missed catch attempts. Other possible factors are the influence of smaller hand size and arm length in young children, which can also make catching and throwing the ball more difficult. Thus, successful EHC requires both the manual motor and visual system (Coppens et al., 2021). Our study showed a decreasing trend at ages below 10 years, which should be of particular concern to PE teachers when designing learning in schools. In particular, EHC dominance has a strong influence on children's object control proficiency. A study by Barnett et al. (2010) explains that proficiency in object control during childhood has a significant impact on proficiency in adolescence, emphasizing the importance of programs designed to enhance object control abilities in elementary schools.

For the JS, raw scores showed that girls outperformed boys in our study, but at age 12, boys outperformed girls. The specific requirements of this jumping task might explain this difference in performance. A more reasonable explanation for the gender influence on motor skills during childhood and (early) adolescence is differences in activity preferences between boys and girls (Barnett et al., 2010; Platvoet et al., 2018; Vandorpe et al., 2011). Girls practice more activities related to outdoor gymnastics (for example, skipping rope), while boys prefer to play with object control tasks (Barnett et al., 2010). According to Coppens et al. (2019) and Vandorpe et al. (2011), BB and EHC tests primarily assess coordination, while the JS and MS test requires strength and endurance for good performance. In contrast with MS, it is clear that JS is a more speed-oriented task and requires speed in addition to strength or endurance.

In our sample of Indonesian children from rural and urban areas, children from rural have better MCn overall. In alignment with the study of Niemistö et al. (2019), the present study result showed that rural children outperformed their urban counterparts on the test protocols. However, when the scores were standardized by age and gender, we also saw differences between school locations using MQ. The difference becomes more significant as rural children outperform urban children. Regarding MQ, rural children scored significantly higher on all four tests. On average, rural children scored 9% better on BB, 16% on JS, 13% on MS, and 10% on EHC than urban children. A reasonable explanation is that rural children have access to freedom of movement and large spaces to play, which can effectively improve children's PA and their MC development. Additionally, rural areas of Indonesia have limited access to transportation and technology compared to urban areas (Bakhtiar, 2014). Therefore, children often walk to school, automatically increasing their physical activity. Our findings might indicate that rural children are more fit than urban children. This might explain why rural children in our sample outperformed urban children, as the tests are highly dependent on physical fitness. Having a better level of fitness as a child is really beneficial for undertaking any activities. Childhood is a period of play, and all children should be able to participate in a variety of activities to strengthen their motor skills throughout this time. Famelia (2018) stated that many children do not achieve proficiency in their fundamental motor skills during childhood, making it challenging to perform sports-related skills successfully.

Early childhood is the perfect time to develop motor skills and build motor competence. Therefore, elementary school has been recognized as an ideal environment for promoting PA in young children (Hardy et al., 2010). PE teachers play an essential role in developing each student's motor competence. PE teachers must be able to create learning models that increase student movement and fitness competence. PE teachers in rural schools frequently use traditional games in the learning process, because traditional games in Indonesia consist of games of balance, strength, and speed (Kancanadana et al., 2021). Further review of Stodden et al. (2008)'s model of the relationship between MCn and PA shows that decreasing PA levels may affect MCn and needs to

be urgently addressed by policymakers. Furthermore, it is anticipated that the popularity of traditional games will decline.

The findings of this research cannot be representative of all Indonesian primary school children because the sample comes from small rural and urban areas with characteristics that are different from those other Indonesian areas. Future studies should include sampling across multiple areas and schools in Indonesia. The first limitation is that we were not provided full-day data on what children did during physical education class and outside of school. Secondly, the KTK3+ test does not fully measure all aspects of gross motor competence (e.g., kicking, walking, and rolling). Gross motor competence plays a crucial role in a child's physical, social, cognitive and emotional development and therefore all aspects should be considered in future research. Encouraging and supporting the development of these skills during childhood can have long-term positive effects on a child's overall well-being and future health.

Conclusion

In this study, the levels of motor competence were compared between Indonesian children from urban and rural areas using KTK3+. According to the current findings, rural children generally score higher on motor competence than urban children. There is a possibility that these results can be explained by differences in physical activity caused by contexts, such as sports activities, exercise habits, and organized exercise, but future research is needed to determine whether physical activity and fitness play a role in motor competence differences between school locations. On average, girls are better at leg strength, while boys excel at dynamic balance, lateral movement, and eye-hand coordination. This suggests that, overall, boys have better skills than girls. However, the findings of our study also indicate a less steady rise in motor performance during the ages of 7 to 9 year-olds. Our study suggests that the KTK3+ test battery is a useful, effective, low-cost and easy-to-use tool for assessing MCn in Indonesian school children aged 7 to 12 years. In addition, the KTK3+ test battery assesses all domains of gross motor skills, including aspects of object control, locomotion and balance.

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Conflict of interest

There is no conflict of interest between the authors.

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