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Differences in Gross Motor Development Among Early School Children: Comparison on Team and Individual Sports

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Abstract

This study aimed to determine the level of gross motor development of children aged eight to ten years involved in individual (I) and team (T) sports by using the Tests of Gross Motor Development-2 (TGMD-2) method. This study is an ex-post factor involving 360 children in their early schooling stages (M = 180, F = 180). The study involved 2 types of sports: individually (Athletics = 60, Badminton = 60, Taekwondo = 60) and team (Handball = 60, Hockey = 60, Basketball = 60). Descriptive analysis has shown the level of performance for individual sports AEL (M = 8.24, SD = 1.02, DR = Average), AEM (M = 7.16, SD = 0.92, DR = Below Average) and GMDQ (M = 87.87, SD = 5.4, DR = Below Average). For team sports, the age equivalence levels of AEL (M = 8.05, SD = 1.23, DR = Average), AEM (M = 7.84, SD = 1.07, DR = Below Average) and GMDQ (M = 90.02, SD = 6.57, DR = Below Average). There was a significant difference for individual and team sports on the AEL score t (358) = 1.64, p = 0.00. While there was no significant difference for individual and team sports on the AEM score t (358) =-6.45, p = 0.27 and GMDQ t (358) =-3.39, p = 0.06. MANOVA analysis showed that there were significant differences for AEL, AEM and GMDQ scores for athletics, badminton, taekwondo, handball, hockey, and basketball with [F (15,972.12) = 11.82, p <0.001, eta squared = 0.14]. Individual sport types had an AEL age delay of -1.27 years and an AEM of -2.15 years in contrast to team sports with an AEL age delay of -1.25 years and an AEM of only -1.37 years. ANCOVA analysis showed that gender and age could influence the level of gross motor development of individual and team sports. Implementing the gross motor development test provides knowledge and information to teachers and coaches to know athletes' gross motor acquisition. Teachers and coaches could also design a training program to help athletes strengthen their gross motor development and improve their athletic performance.

INTRODUCTION

The development of gross motor skills among pre-and early school children is a key indicator for their potential to acquire more complex motor skills when reaching physical maturity. Motor development is a continuous lifelong process that begins in the womb and continues until death (Gallahue & Ozmun, 2006) and two types of motor development are gross motor development and fine motor development (Gesell & Ames, 1940). Hardy et al. (2010), indicated that the early phase of childhood is a critical phase in which gross motor development changes occur rapidly. During

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this phase, the child's gross motor development occurs clearly, and the effect can be seen when the child is able to perform movements by simply imitating them (Shala, 2009). This process involves age, physical growth, and physiological, motor, and nervous systems. Thus, if a person does not go through normal growth at the early stage of life, motor ability loss may occur later on, and as in children might be seen in less engagement in sports and playing activities

(Hardy, 2009). Gross motor skills are essential in childhood for exploring the environment, controlling body movements, manipulating objects, and stabilizing the body (Cools et al., 2009). Adolescents with stronger gross motor development will produce more efficient and effective movement and applied in daily life (Cools et al., 2009). Motor development also involves increasing the diversity of motor skills and movement skills in children (Slotte et al., 2017). The gross motor movement consist of major muscles or large muscles (Taber, 2009), while fine motor movement involves small or fine muscles that focus on movement coordination (Magill, 2001).

Gross motor skills are the ability to use major muscle groups to perform organized joint movements and daily function such as walking, running, throwing, jumping, climbing, and catching (William, 1983). Children ages six to nine undergoing normal developmental stages will develop proper eye-hand and foot coordination to enable them to perform basic motor actions, such as throwing, catching, and hitting with good coordination according to chronological age (Goodway et al., 2003). Locomotor skills are the ability to change body movements in performing activities that involve whole limb changes such as performing gallop skills, running, side -legged jumps, bouncing, long jump standing and side running (Cools et al., 2009; Hardy et al., 2010). While for manipulative skills is the ability to manipulate tools with hand coordination and foot position that has movement or only in a static state. Hitting a stationary ball, bouncing, catching, kicking, tossing, and rolling the ball are examples of manipulative skills (Stodden et al., 2008).

The ability of children to perform gross motor skills at an early age is a demonstration of their gross motor ability in performing those skills. This development stage is crucial because during this period the human biological system is susceptible to change. In addition, previous study presented that the development of motor skills in line with chronological age and intelligence was associated with children's future academic performance (Roebers, 2014). Therefore, the purpose of this study was to find out the age equivalence of locomotor skills score (AEL), age equivalence of manipulative score (AEM) and gross motor developmental quotient score (GMDQ) for individual and team sports. Two categories of sports, individual and team consisting of handball, hockey, basketball, athletics, badminton, taekwondo were compared. Additionally, this study's findings will assist coaches in evaluating the gross motor development of children in a team. As a result, this can improve and strengthen individuals' skills and contribute to a team's success.

METHOD

Study design serves as a guide in research to achieve clear answers to research questions (Kerlinger, 1973). This study is an ex-post factor study that aimed to obtain baseline scores based on AEL scores, AEM scores, and early school children's gross motor development levels to compare with their chronological age norms.

This study involved a total of 360 primary school children in the district of Selangor aged eight to ten years. The students represented the school in the MSSD Selangor district level tournament in athletics, taekwondo, badminton, hockey, handball, and basketball. Each sport represented by 30 boys and 30 girls.

This study used a test instrument (TGMD) by Ulrich (2000). The test consists of six locomotor skills tests and six types of manipulative skills tests on individual and team sports. The TGMD test contains gallop, running, side -legged jump, bouncing, standing long jump and side-running for locomotor skills. Manipulative skills consist of hitting a stationary ball, bouncing, catching, kicking, throwing, and rolling the ball.

The data collected were analyzed using Statistical Package for the Social Science (SPSS) version 20.0. The researcher conducted descriptive data analysis, T-Test, MANOVA and ANCOVA analysis to determine the differences in age equivalence scores of locomotor skills, manipulative and gross motor development levels between individual and team sports, and the relationship of age and age factors among school children.

RESULTS AND DISCUSSION

Levels of age equivalence of locomotor skills score (AEL), age equivalence of manipulative score (AEM) and gross motor developmental quotient score (GMDQ) for individual and team sports.

Based on the findings in Table 1, the mean and standard deviation for individual sports for the AEL scores ((M = 8.24, SP = 1.02, DR = Average), AEM (M = 7.16, SP = 0.92, DR = Below Average) and GMDQ (M = 87.87, SP = 5.4, DR = Below Average). While for team sports, the mean values, and standard deviations for AEL scores ((M = 8.05, SP = 1.23, DR = Average), AEM (M = 7.84, SP = 1.07, DR = Below Average) and GMDQ (M = 90.02, SP = 6.57, DR = Average). The AEL mean score for individual sports were higher than mean score of team sports, but the mean scores of AEM and GMDQ for team sports were higher than mean of individual sports.

Table 1. Descriptive statistic of overall scores for individual and team sports

Type of Sport	Variable	N	Mean	SD	Descriptive Rating
Individual	AEL	180	8.24	1.02	Average
	AEM	180	7.16	0.92	Below Average
	GMDQ	180	87.87	5.4	Below Average
Team	AEL	180	8.05	1.23	Average
	AEM	180	7.84	1.07	Below Average
	GMDQ	180	90.02	6.57	Average

Differences in age equivalence scores of locomotors, manipulative skills, and levels of gross motor development against individual and team sports.

Table 2 shows the differences of age equivalence scores of locomotor skills, manipulative skills, and level of gross motor development in individual and team sports. The findings showed that there was a significant difference t (358) = 1.64, p = 0.001 on the age equivalence score of locomotor skills on individual sports (M = 8.2, SD =

1.0) and team sports (M = 8.0, SD = 1.2).

Table 2. Results of t-test for AEL, AEM and GMDQ by individual and team sports

Variable	Individual		Team		t	df	p
	Mean	SD	Mean	SD			
AEL	8.2	1.0	8.0	1.2	1.64	358	0.00
AEM	7.2	0.9	7.8	1.0	-6.5	358	0.27
GMDQ	87.9	5.4	90.0	6.6	-3.4	358	0.06

Differences in age equivalence scores of locomotors, manipulative skills, and level of gross motor development in athletics, badminton, taekwondo, handball, hockey, and basketball.

Based on Table 3, the results of the MANOVA test shows there is a significant difference for the AEM score [F (5,1.55); p = 0.17> 0.05; value and squared = 0.02] and GMDQ [F (5,6.2); p = 0.00 <0.05: eta squared value = 0.08] on athletics, badminton, taekwondo, handball, hockey, and basketball.

Table 3. MANOVA Analysis of AEL, AEM and GMDQ scores

Dependent Variable	Sum of Square	df	Mean Square	F	p	Eta squared
AEL	9.87	5	1.98	1.55	0.17	0.02
AEM	58.16	5	11.63	12.13	0.00	0.15
GMDQ	1074.46	5	214.89	6.2	0.00	0.08

The findings from the Univariate test in Table 3 show that there are two significant dependent variables namely AEM and GMDQ. Table 4 shows the results of post-hoc tests where there was a significant difference for AEM scores between basketball with athletics (p = 0.01), basketball with taekwondo (p = 0.01). The AEM score between badminton with handball showed a significant difference (p = 0.04), badminton with athletics (p = 0.03). AEM scores for handball with athletics (p = 0.00), handball with taekwondo (p = 0.00). There was a significant difference for AEM scores on athletics with hockey (p = 0.00), hockey with taekwondo (p = 0.00).

Comparison of the GMDQ Score between basketball with all other sports showed no significant difference. GMDQ scores obtained significant differences between badminton with athletics (p = 0.02) and badminton with taekwondo (p = 0.02). There was a significant difference (p = 0.00) for handball with athletics, handball with taekwondo, athletics with hockey and hockey with taekwondo.

What is the age delay of the equivalence score of locomotor skills and manipulative skills on individual and team sports?

The age equivalence analysis was intended to determine which types of sports experienced delays in the age equivalence scores of locomotor and manipulative skills on individual and team sports. The way to find out the delay in the age equivalence score for the type of sport is derived from the results of subtracting AEL and AEM with their chronological age mean. Table 5 shows that individual-type sports had a 1.27 -year delay in the AEL score compared to team sports which had a 1.25

-year delay. For the AEM score for individual sports reached a delay of 2.15 years in contrast to individual sports only reached a delay of 1.37 years.

What is the influence of gender, age, and BMI on the differences in gross motor development for individual and team sports?

The results of the ANCOVA test in Table 6 showed that there was a significant difference of sports type against the dependent variable GMDQ F (1,355) = 27.21, p = 0.00 <0.05. In addition, the control enablers of the study were gender F (1,355) = 60.21, p = 0.00 <0.05 and age F (1,355) = 193.64, p = 0.00 <0.05 showed that there was a significant difference on GMDQ. The BMI control variable did not provide a significant difference on GMDQ F (1,355 = 0.039, p = 0.84> 0.05. These findings indicate that controlling for the gender and age of subjects in each type of sport can influence GMDQ levels.

Table 4. Post hoc analysis of AEM and GMDQ between Athletics, Badminton, Taekwondo, Handball, Hockey, and Basketball

AEM	Basketball	Badminton	0.09	0.18	1.00
		Handball	-0.43	0.18	0.16
		Athletics	0.64	0.18	0.01
		Hockey	-0.29	0.18	0.6
		Taekwondo	0.59	0.18	0.01
	Badminton	Handball	-0.52	0.18	0.04
		Athletics	0.55	0.18	0.03
		Hockey	-0.38	0.18	0.29
		Taekwondo	0.5	0.18	0.06
	Handball	Athletics	1.07	0.18	0.00
		Hockey	0.15	0.18	0.97
		Taekwondo	1.02	0.18	0.00
	Athletics	Hockey	-0.93	0.18	0.00
		Taekwondo	-0.05	0.18	1.00
	Hockey	Taekwondo	0.87	0.18	0.00
GMDQ	Basketball	Badminton	-1.6	1.08	0.67
		Handball	-2.2	1.08	0.32
		Athletics	1.83	1.08	0.53
		Hockey	-2.2	1.08	0.32
		Taekwondo	1.8	1.08	0.55
	Badminton	Handball	-0.6	1.08	0.99
		Athletics	3.43	1.08	0.02
		Hockey	-0.6	1.08	0.99
		Taekwondo	3.4	1.08	0.02
	Handball	Athletics	4.03	1.08	0.00
		Hockey	0.00	1.08	1.00

	Taekwondo	4.00	1.08	0.00
Athletics	Hockey	-4.03	1.08	0.00
	Taekwondo	-0.03	1.08	1.00
Hockey	Taekwondo	4.00	1.08	0.00

Table 5. The analysis showing age delay in AEL and AEM scores

Type of Sports	AEL	Delay	AEM	Delay
Individual	8.24	-1.27	7.16	-2.15
Team	8.05	-1.25	7.84	-1.37

Table 6. ANCOVA Analysis for sport types by dependent variables

Source	Sum of Squares	df	Mean Square	F	Sig.
Gender	1242.87	1	1242.87	60.21	0.00
Age	3997.43	1	3997.43	193.64	0.00
BMI	0.8	1	0.8	0.039	0.84
Sport type	561.77	1	561.77	27.21	0.00
Error	7328.35	355	20.64		

The development level for individual and team sports in this study for individual sports is below average, and team sports is average, similar to the previous studies (Roslan & Abulldah, 2020; Srgo et al., 2017; Baharom et al., 2014). Subjects who obtained the highest scores for SPL and SPM will directly affect the GMDQ score. This condition occurs because there are still going through the stage of development or increasing age during the childhood phase as described in previous studies (Malina et al., 2004). Malina & Katzmarky (2006) have stated that raising children's age will affect changes in their physical characteristics and affect the skill performance of those children. In a nutshell, children's motor skills are necessary to be in line with their growth process; thus, there is no chronological age delay in their motor skills.

Moreover, at the level of age equivalence, AEL shows an average level for both sport types. These locomotor skills require children to run, side jump, and learn some basic skills naturally. For example, Whitall & Getchell (1995) stated that children begin to show their running skills after six months of walking independently. This is because running is a natural movement that will be mastered by children which is an advanced process of walking skills. The mastery of these running skills will improve as the child ages. Thus, the assessment of the age equivalence differences of AEL, AEM and GMDQ was based on paired t-test analysis to see the effect of the three scores on individual and team sports. The findings obtained from this analysis are based on standardized scores (SPL), (SPM) and sub-test percentiles for locomotor, manipulative skills, and motor developmental levels. The analysis has shown that only the age equivalence of AEL is significantly different from AEM and GMDQ towards individual and team sports.

In addition, the age equivalence differences of AEL, AEM and GMDQ were also performed on each sport involved in this study using MANOVA analysis. The MANOVA test was implemented to test the hypotheses, which is no significant diffe-

rences of age equivalence scores of locomotors, manipulative skills and gross motor development levels against athletics, badminton, taekwondo, handball, hockey, and basketball. The analysis indicated significant differences in the age equivalence scores of AEL, AEM and GMDQ for all types of sports. This may be influenced by the type of training performed during their training sessions, which the acquired skills were developed. This is supported by previous studies that the quality of training given to children is essential in developing children's movement skills (Cohen et al., 2014; Sheikh et al., 2011; Amui, 2006).

The researcher determined the age delay of children's gross motor development based on their chronological age. The child age delay in individual sports in this study was -1.27 years (AEL) and -2.15 (AEM).While for team sports it is -1.25 (AEL) and -1.37 (AEM). This finding is in line with previous studies conducted by Lee et al. (2020), Roslan & Abdullah (2020) and Avigo et al. (2019). In this study, the researcher controlled other factors to avoid the variable affecting the findings. In addition to involvement in sports activities, other controlled factors were gender, age, and BMI. ANCOVA results have shown that there are still significant differences for gross motor development between sport types even after controlling the factors such as gender, age, and BMI. The sports activity involvement accounted for 7% of the variance found in the combined mean of gross motor development of subjects despite considering other related factors. The factors contributing to the increase in gross motor growth were gender (15%) and age (35%), but BMI were found did not contribute to the increase in gross motor development.

These results are almost comparable to those of numerous researchers' findings (Shams, 2018; Yang, Lin, & Tsai, 2015; Vameghi et al., 2013), reported a variety of factors that influence children's motor development. This study found that gender and age were able to influence the children's motor development. BMI did not affect the level of gross motor development of children probably because the percentage of BMI of these children is almost the same. The number of children who surpassed the obese level for individual and team sports was almost the same for both sport types. However, gender factors indicated that boys were more active compared to girls who acquired low motor skills, and this finding is consistent with studies of Shams (2018), Yang, Lin, and Tsai (2015), Vameghi et al. (2013).

Children with a more mature age will achieve a higher level of motor development when compared to younger children. The results show that children aged ten years reached higher gross motor development level with mean values of 91.16 (individual) and 93.76 (team). This mean value was the highest produced among the three age groups in this study. The findings indicated that these children do not have specific training sessions to improve their gross motor development level. This condition might be due to their teacher or coach only focusing on particular sports training the to complete good sports performance.

CONCLUSION

The study's findings can be a reference and benefit other sports in ensuring that their athletes can achieve maximum gross motor development. It is also essential to ensure that children's age at this early stage is in line with the period of their gross motor development and can contribute to their involvement in sports and their lives.

As the findings on the level of mastery of AEL, AEM and GMDQ scores for individual-sports are below-average, and for the team-sports is only average, it has shown that these children reach their age delay between 1 to 2 years from their chronological age.

Gross motor development tests performed on children in the early stages of schooling in this study resulted in average and below-average level. Several factors can affect this study's findings, such as too many procedures for them to remember and do in the TGMD-2 test. Subjects also might be unfamiliar with some of the difficulties in the particular test. They may never have done so in training nor daily life, such as gallop, bouncing, hitting a stationary ball, and rolling the ball. The young age of the children makes them unskilled with the TGMD-2 test. Especially to 8-year-old children who have just joined the team within 1-2 years. The students might feel a lack of self-confidence because they are afraid to make mistakes and be noticed by their teacher or coach and thus indirectly bothering them to take the test.

A suggestion to further develop this study regarding developing gross motor in athletes is by evaluating the effect of this TGMD-2 test intervention on the athlete or team's performance. A follow-up study of how the impact of this TGMD-2 test intervention training can contribute to the performance of the athletes and the team concerned after their major tournament participation. An assessment of the intervention's effectiveness will provide an indicator for the team and the athlete. On the other hand, methods and approaches for children who do not participate in sports or physical activities also must be considered. In addition, the existing curriculum should be reviewed and evaluated by experts in children's motor development with the identification of activities that can be implemented while learning in school. This will give an overview on formulating a new curriculum or amendments of the existing one that will positively affect children's gross motor development and positive growth. This is supported by Alhassan et al. (2012), as she reported that children need 120 minutes a day to do activities to improve their physical skills.

Our country has taken the path of intending to produce world-class athletes who can compete internationally at a very young age. Thus, the researcher suggested that the curriculum in physical education subjects or the TGMD test will be considered a compulsory test to be implemented in primary schools to replace the SEGAK test. This will help the country produce competitive athletes at a young age and consistently engage in sports for a more extended period. Therefore, this study was hoping to contribute as its objectives to assess gross motor development in children's early age, especially those involved in sports.

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