

# The Relationship Between Motor Skills and Physical Activity Levels of the Children at 8-10 Years of Age

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## Abstract

The aim of this study is to determine the physical activity levels (PAL) and motor skills (MS) of children aged 8-10, and to investigate the relationship of MS and PAL with body mass index (BMI). A total of 245 (female = 126, male = 119) volunteers aged 8-10 years participated in the study. The PALs of the participants were evaluated by Physical Activity Questionnaire for Older Children (PAQ-C). Gross motor skills of the participants, which is the total value of object control (OC) and locomotor (LOCO) skills were tested by means of Test of Gross Motor Development (TGMD-2) and BMIs were determined by [weight (kg) / height (m<sup>2</sup>)] formula. Pearson Correlation Analysis was used to investigate the relationships between PAL, BMI and MS. A negative correlation was found between BMI and MS in girls. On the other hand, it was also determined that LOCO skills of boys increased as their PALs increased while girls' OC skills increased as their PALs increased ( $p < 0.05$ ,  $p < 0.01$ ). As a result, the fact that PAL is significantly related with LOCO skills of boys and OC skills of girls may be related to the participation of children in the types of activities required by their gender. In addition, it was observed that PAL and MS levels of children are low. Considering that motor skill plays an important role in the physical structure and psychological condition of people during their childhoods and whole lives, it can be said that developing both MS and PAL by directing children to physical activity is extremely important.

**Key words:** Children, motor skill, physical activity, BMI, TGMD-2

## INTRODUCTION

Participating in physical activities (PA) is part of development in children. The International Classification of Function, Disability and Health for Children and Youth (ICF-CY) emphasized the importance of PA in children (34). Although PA has been common during childhood (9), there has been a trend towards a more sedentary life in recent years (1).

Although children have plenty of free time, they do not spend much of this time on PA and games that develop motor skills (21). The therapists dealing with children have reported that children spending their free time on physical activities and games are better in terms of mental and physical well-being (35). PAs help with motor development and create the basis of proper health (28). Several studies have reported that low Motor Skill (MS) and low Physical Activity Level (PAL) have a strong correlation with each other (7,33). In fact, the main reason is that children with low motor skills avoid participating in

physical activities. Motor development in children who do not participate in PA is limited; besides, they have lower motor skills than their peers and thus causing physically negative conditions (2,22). The most important of these negative conditions is that low PAL and MS may cause overweight in children (23). To sum up, it is possible to state that low MS decreases the desire for participating in physical activities in children and low physical activity causes obesity.

Fransen et al. (8) reported that the children with high motor competence were more successful in physical fitness tests, and they participated in sports activities more than their peers. Stodden et al. (27) noted that there was a strong relationship between PA, MS, physical fitness and obesity. As a result of low level of MS, participation in PA decreased causing adverse health effects and weight gain as well as obesity. It is evident that there is a strong relationship between MS, PAL and BMI.

8 and 10 ages which constitute critical periods in children's development towards their adult health status. Moreover, the relation between children's ages and PAL as well as their MS after age 8 and 10 allow us to estimate the causal effect of conditions at certain ages on adult life. Therefore, the purpose of this study was to investigate the relationship between MS, PAL and BMI among children aged 8-10 years and determine the MS and PAL levels of the study subjects.

## MATERIAL AND METHOD

There are various reasons why the subjects were chosen at certain ages. The most general related concerns were the identification of critical age in human development. Since negative conditions at a certain age before reaching adulthood have particularly severe long-run effects on health, the quality of life is reduced for those who are affected. Considering the long-run effects of conditions during childhood on health in adulthood, this may be smaller than the instantaneous effects of current conditions, but the former exert their influence over a longer time span. Moreover, the presence of a time interval between childhood and the manifestation of the effect implies that there is a scope for identification of the individuals at risk. The randomly chosen subjects were those who studied at different schools at Nigde province in Turkey. The most important reason to determine the criteria of choosing subjects was that they were all healthy individuals.

Therefore, 126 female and 119 male voluntary children aged 8-10 years participated in the study. The children who participated in the study were informed and necessary permissions were obtained from their families. Physical Activity Questionnaire (PAQ-C) was used to determine the physical activity levels of the children who participated in the study and each child was asked to complete Test of Gross Motor Development (TGMD-2) was performed in order to determine the motor skills of the subjects. The test was described and illustrated once, but no correction was made during the test.

### Physical Activity Questionnaire for Older Children

Physical Activity Questionnaire for Older Children (PAQ-C) was developed by Crocker et al. (5), and adapted into Turkish by Sert and Temel (24) who conducted validity and reliability studies PAQ-C for children aged 8-14 years. PAQ-C is a measure

that assesses the activities performed during a 7-day period, and could be filled in by the individuals. It evaluates general PALs of children up to 8-14 years of age. The PAQ-C scale for reminiscent of activities in the last 7 days is applicable in the classroom environment and provides insight into participants' general physical activity habits. PAL consists of nine questions and each question is evaluated between the score of 1 and 5 and in determining the total score, final score is divided by 9. In PAQ-C scale, 5 indicates the highest 1 indicates the lowest score. In calculating the physical activity scores of the participants in the study, the average of all scores related to the questions is taken into consideration. They are classified as inactive, moderately active according to the reference values obtained from PAQ-C scores of the children who participate in the study.

### TGMD-2 (Test of Gross Motor Development)

The Test of Gross Motor Development Second Edition (TGMD-2) (30) was performed to assess fundamental motor skills. The TGMD-2 is considered as a criterion and norm-referenced standardized test that quantitatively assesses the fundamental motor skills of children between the ages of 3 and 10. The test consists of 12 items and they were grouped into two sub-scales; LOCO and OC. The loco-motor subscale focuses on six LOCO skills (running, leaping, horizontal jumping, sliding, galloping and hopping). On the other hand, OC focuses on throwing, kicking, catching, striking, dribbling, and rolling make-up. Each skill is evaluated using 3 to 5 performance criteria. For example, one performance criterion for running was the 'arms move in opposition to the legs with the elbows bent.' If participants demonstrate this behavior, they take the score called '1'; if they do not demonstrate the behavior, they take the score called '0'. The raw scores from the two TGMD-2 subscales (LOCO and OC) range from the scores between 0 and 48. The two sub-scale scores are combined and yield the TGMD-2 total score that ranges from the lowest 0 to the highest 96. A higher raw score and total score represent higher MS competence, while lower raw scores and total score indicate the absence of critical elements (i.e. lower motor skill competence). The LOCO and OC skill raw scores were used for the analyses instead of the standard scores for the following reasons.

The total scores of LOCO and OC skills constitute Gross Motor Skills score, which was

transformed into total GMS after converting LOCO skill total score and OC skill total score into standard scores. Total GMS score was calculated in this way. The GMS score was classified in 6 levels as very poor, poor, below average, average, superior, and very superior (30).

**Table 1.** Classification of motor coordination levels according to motor scores of TGMD-2

Gross Motor Skills Standard	
Descriptive Rating	Score
Very Poor	<70
Poor	70-79
Below Average	80-89
Average	90-110
Above Average	111-120
Superior	121-130
Very Superior	>130

### Statistical Analysis

Statistical analysis was conducted through Statistical Package for Social Sciences (SPSS 24.0), which is statistical package software programme developed by IBM Company in Armonk, New York, the USA. In order to determine demographical information and physical properties and TGMD-2 sub-score test scores, the descriptive analysis was conducted. The relationship between PAL BMI and TGMD-2 sub-dimensions in terms of the children was determined through Pearson correlation analysis. Percentage frequency analysis was performed for the categorical data. In the current study, the level of significance was determined as  $p < 0.05$ ,  $p < 0.01$ .

## FINDINGS

**Table 2.** Demographical features of the children according to age and gender

	Male			Female			Total		
	8 Years Old (n=35)	9 Years Old (n=46)	10 Years Old (n=38)	8 Years Old (n=42)	9 Years Old (n=46)	10 Years Old (n=38)	8 Years Old (n=77)	9 Years Old (n=92)	10 Years Old (n=76)
<b>Weight (kg)</b>	32,37 ±6,53	36,72 ±6,62	37,87 ±7,36	28,86 ±5,07	33,78 ±4,80	36,03 ±6,97	30,45 ±6,00	35,25 ±5,93	36,95 ±7,18
<b>Height (cm)</b>	133,63 ±8,48	139,50 ±8,43	143,84 ±10,06	131,12 ±6,39	139,54 ±7,28	144,74 ±9,11	132,26 ±7,46	139,52 ±7,83	144,29 ±9,54
<b>B MI (kg/m<sup>2</sup>)</b>	18,03 ±2,61	18,92 ±3,43	18,33 ±3,08	16,81 ±2,71	17,33 ±1,98	17,21 ±3,20	17,36 ±2,71	18,13 ±2,90	17,77 ±3,17

**Table 3.** MS and PAL of children according to age and gender

	Male			Female			Total		
	8 Years Old (n=35)	9 Years Old (n=46)	10 Years Old (n=38)	8 Years Old (n=42)	9 Years Old (n=46)	10 Years Old (n=38)	8 Years Old (n=77)	9 Years Old (n=92)	10 Years Old (n=76)
<b>LOCO</b>	31,54 ±7,48	33,20 ±6,34	34,76 ±6,95	34,38 ±5,85	31,59 ±5,23	35,42 ±5,33	33,09 ±6,74	32,39 ±5,83	35,09 ±6,16
<b>OC</b>	30,74 ±5,63	32,87 ±6,20	34,37 ±4,91	29,79 ±6,95	31,67 ±5,68	33,21 ±4,89	30,22 ±6,36	32,27 ±5,94	33,79 ±4,90
<b>GMS</b>	67,69 ±10,62	67,07 ±12,95	70,39 ±10,65	70,00 ±9,76	63,54 ±9,44	69,45 ±10,60	68,95 ±10,15	65,30 ±11,41	69,92 ±10,56
<b>PAL</b>	2,94 ±0,61	3,05 ±0,81	3,24 ±0,80	3,15 ±0,76	2,88 ±0,98	3,20 ±0,83	3,05 ±0,69	2,96 ±0,89	3,21 ±0,81

**Table 4.** The classification of GMS scores through percentage

Levels	N			Percentile		
	Female	Male	Total	Female (%)	Male (%)	Total (%)
<b>Very poor</b>	72	62	134	57,1%	52,1%	54,7%
<b>Poor</b>	39	38	77	31,0%	31,9%	31,4%
<b>Below average</b>	14	13	27	11,1%	10,9%	11,0%
<b>Average</b>	1	6	7	,8%	5,0%	2,9%
<b>Above average</b>	0	0	0	0,0%	0,0%	0,0%
<b>Superior</b>	0	0	0	0,0%	0,0%	0,0%
<b>Very Superior</b>	0	0	0	0,0%	0,0%	0,0%

When the table 4 is examined, the poor and very poor categories of both male and female are found to be at the highest level as percentage. Besides, there are no male and female subjects in the categories as superior demonstrating the highest level and above and average and very superior demonstrating the intermediate level.

**Table 5.** The relationship between MS, PAL and BMI of children

		Female			
		LOCO	OC	GMS	PAL
PAL	r	,105	,210*	,212*	
	p	,244	,018	,017	
	n	126	126	126	
BMI (kg/m <sup>2</sup> )	r	-,240**	-,141	-,218*	,023
	p	,007	,114	,014	,800
	n	126	126	126	126
		Male			
PAL	r	,260**	,161	,242**	
	p	,004	,081	,008	
	n	119	119	119	
BMI (kg/m <sup>2</sup> )	r	-,154	,042	-,100	-,116
	p	,095	,653	,278	,211
	n	119	119	119	119

\* p&lt;0.05 \*\*p&lt;0.01

According to Table 5, while a positive relation is detected between PAL and OC - GMS ( $p<0,05$ ) of female subjects participating in the study, there is a negative relation between BMI and LOCO skill ( $p<0,01$ ) and GMS ( $p<0,05$ ). There is a positive relations between PAL and LOCO skill and GMS ( $p<0,01$ ) of male subjects.

## DISCUSSION

In today's world, the scarcity of playgrounds (3), and the improvements in technological devices (29) have caused children to adopt a more sedentary life style. Williams et al. (33) reveal that today children spend daily 600 kcal less energy average than their peers did 50 years ago. Thus, low PA restricts the development of motor skills in children. Ružbarská (23); Chovanová (4); and Stodde et al, (26) reported a positive relationship between PA and MS. The children with serious MS problems and low MS level did not participate in physical activities, and thus limiting their motor developments (2,22,27).

It was noticed that the male and female subjects who participated in the study had "low" and "medium" physical activity levels, and it was determined that MS levels were in "very poor" and "poor" categories. In a study conducted through TGMD-2, which was used in the current study, it was determined that 10% of the American children were in "poor" and "very poor" categories in terms of their MS, and "below average" and "average" categories had the highest percentage (13). In another study, Mukherjee et al. (16) the motor development of children at 6-9 ages was analyzed with TGMD-2 test, and it was concluded that motor skill levels of the children were at "average" and

"below average" level. In their study conducted with 2740 children at 6-12 ages in western part of Belgium (32) the motor skills of the children was conducted with KTK test, and compared the KTK scores of the children with the KTK scores of German children in 1974 (12). Vandorpe et al. (32) reported that KTK motor skill scores of children decreased when compared with those living in Germany 35 years ago. It was specified that MS and PA values in aforementioned studies were also low, which paralleled with the results is obtained in the current study.

In fact, low MS and PA level of children has been one of the most fundamental problems in today's world. Although there are several factors influencing motor skills, PA is remarkably important to increase MS. Previous studies revealed that children needed comfortable areas to play games including physical activities (6). However, urbanization and unplanned settlement due to modernity level of the societies and the increase in industrialization have remarkably decreased children's playgrounds (3). Furthermore, the reasons such as playing with computer games through tablets and mobile phones and the increase in the amount of time they spend on watching television have increased sedentary activities and decreased sportive activities (14,19,20,29). As already mentioned above, there are various factors leading children to sedentary life styles, which causes a significant decrease in PA and MS levels of the children.

During the developmental period, there is a weak relationship between physical development and motor competence. However, it has still been under debate whether gender differences have an important effect on MS. In terms of motor performances, gender differences have been investigated depending upon four different factors such as body size, anatomic structure, physiological functions and social and cultural differences.

The most important property specifying the gender difference in motor performance is social and cultural differences. As of their birth, depending on their gender, children are supposed to do whatever they are expected, which causes social pressure on them. During their childhood, female and male children are considered to be stereotype, and this has also been maintained by their teachers in their subsequent schooling period (15). Such factors have an effect on MS development and types

of activities in which children participate. In previous studies, OC skills of female children such as throwing, catching and dribbling were mentioned to be higher than the male children (11,17,25,31), which is considered to stem from two reasons. First, the situations and games children participate in due to the conditions of cultural structure of their society, and the other is their participation in physical activities. Female children need more social and family support than male children in terms of the participation in physical activities (10).

It was noticed that there was a positive significant relationship between PA levels and OC skills of the female subjects who participated in the current study. Since female children participate in the activities which develop their OC skills more instead of such activities as jumping, jumping and running that develop LOCO skills, which is considered to develop OC skills more. In the current study, it was determined that there was a positive significant relationship between PA level and LOCO skills of male children. Adequate level of strength is required to keep the body off the ground in LOCO skills such as jumping and hopping. For that reason, lower extremity muscle strength has a significant effect on LOCO skills (17,18). It has been considered that male children's preference for such sports as soccer and basketball. In such games, activities include catching, jumping and hopping, which allows children's LOCO skills to develop. Moreover, in the current study, since there was a significant relationship between GMS and PA level in both male and female children, the researchers considered that female children were more dominant in OC skills, whereas male children were more dominant in LOCO skills.

In the current study, it was found that there were two important results. The first one was gender differences, which cause the different kinds of development of motor skills in children. This was coherent with the relationship between OC skills and PA levels of female children and LOCO skills and PA levels of the male children. The second result was the negative effect of the decrease in PA level on motor skills. Considering that motor skill was a significant factor at any period of life as of childhood, it was possible to mention that motor skills should be improved through directing the children towards physical activities. Furthermore, it can be considered that the factors such as spending more time with technological devices, the increase in the number of course hours children are involved in

and fewer playgrounds are significant for the decrease in the development of motor skills.

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