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The Evaluation of the Intellectual Disabled Children's Fundamental Motor Skill Proficiency

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Abstract: The aim of this cross-sectional study is to determine the fundamental motor skills (FMS) proficiency of children with mild intellectual disabled (MID) and to compare their FMS proficiencies in terms of age and gender. This study has three purposes. These are a) Defining the FMS proficiencies of the participants, b) Examining the FMS proficiencies of the participants in terms of gender variable, c) Examining the FMS proficiencies of the participants in terms of the age variable. Participants consisted of 122 MID students aged 7-10 years (M = 8.25, SD = 0.92). FMS proficiency was evaluated with the Gross Motor Development Test-Second Edition (TGMD-2). Independent Samples t test and ANOVA test were used to test the differences between groups. As a result: a) It was observed that the participants could not perform the FMS at the mastery level. Participants failed to demonstrate FMS proficiency appropriate for their age and showed delays in FMS compared to the TGMD-2 normative sample. Most of the participants performed "below average" and "poor" for Locomotor and Object Control skills. It was determined that the participants obtained higher scores in Locomotor subtest compared to Object Control subtest, b) It was determined that boys were more FMS proficiency and subtests than girls, c) No difference was found in FMS proficiency in terms of age. These results show that opportunities need to be increased to develop the FMS proficiency.

Keywords: *Fundamental motor skill, intellectual disability, locomotor, object control.*

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Introduction

There is a worldwide trend of declining motor proficiency in both children with intellectual disabilities (ID) and typically developing (TD). Studies have been carried out in the United States of America (Rosenberg et al., 2008), Australia, Belgium (Bardid et al., 2015; Simons et al., 2007), Brazil (Spessato et al., 2013), South Korea (Kim et al., 2014), Germany (Niemeijer et al., 2006), Canada (Bremer & Lloyd, 2016), Singapore (Mukherjee et al., 2017) and Netherlands (Niemeijer & Smits-Engelsman, 2007; Westendorp et al., 2011), which show this downward trend. This tendency has been reported to result from increased sedentary life and less participation in physical activity. In addition, children participating in the study conducted in Belgium and Australia had significantly lower fundamental motor skill scores than children of 40 years ago (Bardid et al., 2015).

Gross motor skills, also known as fundamental motor skills (FMS) and gross motor skills, involve the movement of large muscles of the body. Most sport skills are classified as gross motor movements, with the exception perhaps of target shooting, archery, and a few others (Gallahue et al., 2012). Locomotor skills require all movement of the body and include skills such as running, galloping, hopping, leaping, jumping and sliding (Foweather et al., 2008; Okely et al., 2004; Ulrich, 2000).

FMS forms the basis for more improved and complex new motor skills (Gallahue et al., 2012; Haywood & Getchell, 2009). FMS is permanent throughout life and is best learned in prepubertal period (under 12) years (Gallahue & Ozmun, 2002; Payne & Isaacs, 2002). Burton and Miller (1998) stated that most of the skills used in sports and movement activities are the advanced versions of FMS. These skills help children develop control over their bodies, manipulate their environment, and create complex movement patterns related to sports and recreation (Goodway & Branta, 2003). It has been suggested that the poor motor performance observed in MID children is associated with impaired mental function (Hartman et al., 2010), and they have been shown to exhibit worse FMS than TD children (Westendorp et al., 2011). In addition to competence in mental functions, the lack or limitation of movement and

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experimentation opportunities negatively affect the motor skill performance of children (Gallahue & Ozmun, 2002). In addition, children who cannot gain mastery in FMS behave reluctant and timid to learn more complicated skills (Kerkez, 2012).

The development of the FMS is not a naturally acquired process, contrary to bias, and it is sufficient by educators, parents and healthcare professionals to ensure that children use the movement skills that make up FMS properly which requires time, motivation, instruction and encouragement (Stodden et al., 2008). It is thought that maturation in FMS contributes to the physical, cognitive and social development of children (Payne & Isaacs, 2002) and forms the basis for an active lifestyle (Gallahue & Ozmun, 2002; Stodden et al., 2008). FMS proficiency is consistent with positive outcomes such as participation in physical activity (Houwen et al., 2010; Logan et al., 2015; Okely et al., 2001), predicting obesity (Stodden et al., 2008), quality life (Cihan et al., 2019) and reducing disease risks (Lubans et al., 2010). FMS's relationship with physical activity has led health and education professionals to propose active inclusion of FMS education in physical education programs (Bailey, 2006; Haywood & Getchell, 2009).

In Turkey in the 2019-2020 academic year the official primary school attached to the Ministry of Education has received 146.644 students with MID (Ministry of Education, 2020). This number corresponds to 0.88% of all students (16.612.161 students in total). Intellectual disability can be characterized by limitations in mental functions such as learning, reasoning, problem solving, perception, and adaptation skills (American Association on Intellectual and Developmental Disabilities [AAIDD], 2007). Mental function is usually measured with the intelligence quotient (IQ) test (Schalock, 2011). According to the psychological classification of intellectual disabled (ID). Children with 50-75 IQ are classified as MID (Krebs, 2005). Individuals with ID are thought to have difficulty processing complex information and learning new skills (Schalock et al., 2010), resulting in cognitive, language, and motor deficiencies (Pratt & Greydanus, 2007).

With limited research which has been done children with MID, FMS proficiency in literature and the lack of research in Turkey, this group has been the main starting point for this research. The primary aim of the study is to determine the FMS proficiency of MID students. Secondarily, it is aimed to compare the FMS proficiencies of MID students in terms of age and gender. Thus, it is aimed to support evidence-based programs for students with MID. It is hypothesized that FMS proficiency is weak in MID students, and gender and age are effective in FMS proficiency.

Children with MID may need to be supported due to difficulties with their participation in school activities, independence in daily life, and gross and fine motor tasks. If these services are not provided, children's social and emotional development may be further delayed as a result of their unsuccessful school experiences (Sherrill, 1998). Therefore, evaluation of motor functions is of paramount importance to provide a cross-section of the strengths and weaknesses of motor development. Moreover, knowing the developmental characteristics of children is a must for effective teaching.

Methodology

Research Design

In this research, in order to evaluate the FMS levels of MID students, scanning model was used to reach the necessary information. The aim of this cross-sectional study is to determine the fundamental motor skills (FMS) proficiency of children with mild intellectual disabled (MID) and to compare their FMS proficiencies in terms of age and gender.

Sample *and Data Collection*

The study consisted of 122 students (mean age: 8.25, SD = 0.92 years; 56 girls, 66 boys) in the 7-10 age group, without down syndrome and physical disability. Participants are mild intellectual disabled (educable) students who study in 14 public special education classes in Kırıkkale province.

Anthropometric measurements were made height and weight, with a standard portable wall-mounted stadiometer recorded to the nearest centimeter and weight with electronic scales (Tanita BC-418MA, USA) to the nearest 0.1 kg using a medical scale in Bioelectrical Impedance Analysis (BIA) application. Body Mass Index (BMI) was calculated with the formula Weight / (Height x Height) (Mackenzie, 2005).

FMS was evaluated using the validity and reliability of the second edition of the Test of Gross Motor Development (TGMD-2; Ulrich, 2000). TGMD-2 Test; It consists of six locomotor (run, gallop, hop, leap, jump, slide) and six object control (strike, dribble, catch, kick, throw, roll) subtests. The TGMD-2 Test proficiency evaluates the fundamental motor skills of children aged 3 to 10 according to the mature movement pattern criteria for each skill rather than the result. The test is one of the most frequently used instruments to assess fundamental movement skills of children with disabilities (Capio et al., 2017; Eguia et al., 2015; Evaggelino et al., 2002; Houwen et al., 2010; Kim et al., 2012; Schott & Holfelder, 2015; Simons et al., 2007; Simons & Eyitayo, 2016; Westendorp et al., 2011).

The reliability coefficients of the TGMD-2 Test were between 0.76-0.88 for Locomotor skill, 0.85-0.90 for Object Control skill, and 0.87-0.93 for the total test (Ulrich, 2000). TGMD-2 test standardization made in Turkey by Boz and Aytar

(2012) and the test reliability coefficient was determined in the 0.88-0.92 range. The test-retest reliability coefficient was 0.89 for the Locomotor skill, 0.92 for the Object Control skill, and 0.87 for the total test (Ulrich, 2000).

All procedures of the study have been approved to comply with ethical principles with the decision of Aksaray University Human Research Ethics Committee, numbered 2020/13-77. MID students studying in special education classes in the province of Kırıkkale were invited to work in the 2019-2020 academic year. Parents of 134 students with MID agreed to participate in the study and the parents were asked to complete a questionnaire to verify the inclusion/exclusion criteria. The questionnaire included questions about the date of birth (day/month/year), diagnosis and health histories. A total of 122 participants met all the inclusion criteria and formed the sample of the study. The parents of the students signed the "Informed Consent Form".

In groups of five, the participants were taken to the gym, and their height (cm) and weight (kg) measurements were made with a wall-mounted stadiometer and digital scale. These measurements were followed by the TGMD-2 test. The two physical education teachers who worked in the field of adapted physical education and had 20 years of seniority. The researchers first demonstrated each student's skill by making a separate explanation and modeling for each skill. After modeling and explanations, each student performed the skill twice under the supervision of the researcher and special education teacher. No verbal or physical assistance was provided during the application. The application took approximately 15 minutes for each child.

FMS performances of the participants were recorded with a video camera. Video camera shots were made at 25 frames per second (FPS) from both front and side angles. Video images have been given a number to assist in data entry and to hide the identity of the participants. The video footage was scored by two independent physical education teachers who have worked with this age group, with a professional seniority of 18 years or more. First of all, the performance criteria of the skills in the TGMD-2 Test were examined by the raters. A total of 12 skills consisting of both subtests (locomotor and object control) in the TGMD-2 Test are scored in order. Each motor skill includes performance criteria ranging from 3 to 5 items. These items represent a part of the skill in general. If the performance performed is accepted as successful, 1 point is given, and 0 if it is considered unsuccessful. Scores between 0 and 48 for the Locomotor skill subscale and between 0 and 48 for the Object Control Skills subscale are added together. Using the raw score to compare two children of different ages, standard scores that take age into account can be calculated. Classification percentage and age equivalent were calculated depending on the age and gender of the child.

Analyzing *of Data*

The data obtained were analyzed with Statistics Package for Social Sciences version 22 (SPSS 22.0). After the descriptive analysis of the data, their normality was tested with the Shapiro-Wilks test. Since the data showed normal distribution, Independent Samples t test and ANOVA test were used to test the differences between groups. Error level was accepted as $p < 0.05$. The Locomotor subtest showed an acceptable value of $\alpha = 0.89$ for the Object Control subtest for the Cronbach's alpha internal consistency level of $\alpha = 0.86$. The correlations (Pearson Correlation Coefficient) for inter-rater reliability were 0.92 for the Locomotor skill, 0.94 for the Object Control skill, and 0.96 for the total test.

Findings / Results

The descriptive information of the participants is summarized in Table 1.

Table 1: Information on the descriptive characteristics of the students participating in the study

	N	Minimum	Maximum	M	SD
Age (years)	122	7.8	10.2	8.25	0.92
Weight (kg)	122	16.20	63.20	30.12	6.04
Height (cm)	122	117.00	142.20	129.51	5.86
BMI (kg/m^2)	122	10.71	35.73	17.88	2.94

M = mean; SD = standard deviation; BMI: body mass index

Information on the descriptive characteristics of the students participating in the study are given in Table 1. The mean age of the participants was 8.25 ± 0.92 years; weight 30.12 ± 6.04 kg; their height is 129.51 ± 5.86 cm and BMI is determined as 17.88 ± 2.94 kg / m^2.

Table 2: Comparison of FMS proficiencies according to the socio economic status variable of participants (n = 122)

FMS	Socio Economic Status	N	M	SD	F	p
Locomotor	Low	67	29.63	8.28	2.621	0.08
	Middle	48	28.46	8.31		
	High	7	22.14	8.49		
Object Control	Low	67	26.13	8.44	1.98	0.14
	Middle	48	24.08	7.85		
	High	7	20.57	7.39		
GMQ	Low	67	55.76	15.92	2.385	0.10
	Middle	48	52.54	15.78		
	High	7	42.71	14.99		

GMQ=Gross Motor Quotient

As a result of the ANOVA test analysis, no statistically significant difference was found between the TGMD-2 test scores in terms of socio economic status variable ($p > 0.05$).

Table 3: Raw scores of the students participating in the study from TGMD-2 Test, locomotor and object control subtests.

FMS	N	Minimum	Maximum	Maximum points that can be obtained	M	SD
Run	122	2	8	8	5.80	1.66
Gallop	122	0	8	8	3.98	1.91
Hop	122	0	10	10	5.82	2.26
Leap	122	1	6	6	4.12	1.47
Jump	122	0	8	8	4.73	1.88
Slide	122	0	8	8	4.29	1.84
Locomotor	122	8	48	48	28.74	8.41
Strike	122	0	6	10	3.25	1.40
Dribble	122	0	8	8	4.80	1.85
Catch	122	0	6	6	4.54	1.40
Kick	122	0	8	8	3.66	2.31
Throw	122	0	8	8	4.31	1.90
Roll	122	0	8	8	4.45	2.09
Object Control	122	8	43	48	25.01	8.23
Total score	122	16	91	96	53.75	16.00

M = mean; SD = standard deviation

The average scores of the participants from the TGMD-2 test are given in Table 3. Locomotor skill scores were 28.74 ± 8.41; Object Control skill scores of 25.01 ± 8.23; TGMD-2 total scores; It was determined as 53.75 ± 16.00. The highest FMS sub-skill score was obtained in hop (5.82 ± 2.26) and run (5.80 ± 1.66) skills. The lowest FMS sub-skill score was obtained in strike (3.25 ± 1.40), kick (3.66 ± 2.31) skills. Among the 122 participants, none of the students could get the maximum score for strike skill. It is seen that the participants performed better in Locomotor skills (28.74 ± 8.41) than Object Control skills (25.01 ± 8.23).

Table 4: Comparison of FMS proficiencies of participants (n = 122)

FMS	Group	N	M	SD	t	df	p	Cohen-d
Locomotor	Girls	56	25.25	7.12	-4.549	120	.000*	0.83
	Boys	66	31.70	8.33				
Object Control	Girls	56	21.77	7.06	-4.284	120	.000*	0.78
	Boys	66	27.76	8.20				
GMQ	Girls	56	47.02	13.18	-4.625	120	.000*	0.85
	Boys	66	59.45	16.04				

*p<0.05, M = mean; SD = standard deviation, GMQ=Gross Motor Quotient

It is seen in Table 4 that male students obtained higher Locomotor, Object Control and GMQ raw scores than girls as a result of the independent Samples t test analysis. According to this result, it can be said that the FMS performance of male students is statistically better than girls ($p < 0.05$). The effect size value was found to be large for the "Locomotor skills" sub-dimension ($d = 0.81$), "Object control skills" sub-dimension ($d = 0.78$) and "Gross Motor Skills" sub-dimension ($d = 0.85$).

Table 5: Comparison of FMS proficiencies according to the age variable of participants (n = 122)

FMS	Age	N	M	SD	F	p
Locomotor	7	29	28.62	9.53	.221	0.882
	8	44	29.23	7.64		
	9	38	28.79	8.84		
	10	11	26.91	7.53		
Object Control	7	29	23.90	9.07	.333	0.801
	8	44	24.89	7.10		
	9	38	25.63	9.17		
	10	11	26.27	7.38		
GMQ	7	29	52.52	18.10	.090	0.966
	8	44	54.11	14.06		
	9	38	54.42	17.46		
	10	11	53.18	13.98		

As a result of the ANOVA test analysis, no statistically significant difference was found between the TGMD-2 test scores in terms of age variable ($p > 0.05$). However, in general, except for 10-year-old students, it is seen that FMS scores increase as age increases in other age groups.

Discussion

In this study, the low motor proficiency levels of MID children in FMS and all sub-skills are clearly seen. According to the findings of the study, it was determined that the participants did not become masters of FMS and their scores were significantly lower than the normative data. According to the results of the TGMD-2 Test, a child who is below the twenty-fifth percentile is considered to be delayed in terms of motor development (Ulrich, 2000). This result is in parallel with previous research showing that ID children have poor FMS proficiency (Capio et al., 2016, 2017; Eguia et al., 2015).

It can be said that children with MID generally learn gross motor skills more difficult than their TD peers (Sherrill, 1998), so they need more systematic and planned learning experiences.

Contrary to the study, higher FMS scores were obtained in some studies conducted with children with ID (Kim et al., 2012; Schott & Holfelder, 2015; Simons et al., 2007; Simons & Eyitayo, 2016; Valentini & Rudisill, 2004; Westendorp et al., 2011). This difference may be due to the younger ages of the students participating in the study than participants in the other studies.

Participants in this study were not able to reach the mastership of FMS. It may have been caused by intellectual impairments having a negative impact on the development of FMS. As theoretical knowledge is required for successful performance of motor tasks (Magill & Anderson, 2016), children with intellectual disabilities tend to have low motor performance for this reason (Hartman et al., 2010). FMS, active lifestyle and obesity, play a key role for health. These results are a major source of concern for children. In addition, an extensive research was conducted with children in Turkey TD children 6-10 age group, 6.5% of children were obese, and 14.3% were found to be overweight (Ministry of Health, 2020). In Turkey physical education teachers are not employed for physical education lesson in primary schools; primary classroom teachers teach instead. Moreover, not sufficient time is given for physical education classes and those may have led to these results. In addition, primary classroom teachers who take physical education and game lessons in primary schools should offer different options to students (Eldeniz Cetin & Cay, 2020).

Instead of always engaging students in one type of activity, different options should be offered. For the motor development children, need to be physically active and play outside. It is stated that children who do not or cannot participate in activities and games have regressed in terms of motor fitness and have a great deal of skill loss (Ozer, 2005). TD children's, gender differences in Object Control skills are probably due to social factors that may be associated with interaction with teachers, peers and families as well as play leading to adequate skill application. It has been suggested that it is affected by the interactions. In TD children, lack of FMS proficiency has been expressed as valuable in providing free play opportunities (Hardy et al., 2010). Children in Turkey generally have unstructured play opportunities in the playground. Locomotor skills may have been demonstrated better than Object Control skills in the research, as Locomotor skills are often used in unstructured games and no tools are needed.

In addition to the inadequacy of play opportunities, body awareness problems have also been revealed in children with ID (Sherrill, 1988). Besides body awareness; problems with balance, postural control, and strength have been reported (Block, 1991). On the other hand, Krebs (2005) stated that the reason why most of the intellectual disabled children show developmental motor delays is related to limited attention and understanding rather than physiological or motor control deficiencies.

Moreover, it has been reported that children with low socioeconomic backgrounds and lack of nutrition and lack of health care may cause serious health problems (Eripek, 2005). Low socio economic status increases the risk of low motor proficiency in children (Morley et al., 2015). However, the study found out that socio economic status did not affect gross motor skills. This result may be due to the small sample size.

Locomotor skills have been shown to perform better than Object Control skills. This result may be due to the fact that Object Control skills are more complex and involve more cognitive functions than Locomotor skills (Planinsec, 2002; Planinsec & Pisot, 2006). Object control skills are often applied in complex game and sports environments that require adaptation to changing environmental conditions (Houwen et al., 2007). Performance in complex situations is assumed to be difficult for ID children. Therefore, ID children may have more problems with Object Control skills than with Locomotor skills.

None of the participants got the maximum score in strike skill. The reason for this may be that baseball bat and movement patterns of baseball sport are not used in games played in Turkey. It has been determined that male students have higher FMS proficiency than female students. This finding supports the hypothesis that gender is effective in FMS proficiency. In the study conducted by Simons et al. (2007) with MID students in the 7-10 age group, it was determined that male students were better than female students in Object Control skills, while Locomotor skills did not differ in terms of gender. This result partially supports the study. Some studies reported that TD boys scored higher than girls in Object Control skills (Krebs, 2005; Ulrich, 2000; Woodard & Surburg, 2001).

In the study conducted by Capio et al. (2016) with ID children, no difference was found in FMS proficiencies in terms of gender. This result is not consistent with our study findings. Boys participate in physical activities more and families support them more than girls and these may be possible reasons for gender differences in FMS proficiency. Boys in Turkey get more social support than girls to participate in physical activity.

No significant difference was observed in the performances of the participants according to their ages. According to this finding, the hypothesis that the age variable is effective in FMS sufficiency is not supported. In the study of Simons et al. (2007); there was no difference in Locomotor subtests in terms of age, but in Object Control skills subtests, as age increased, FMS scores increased. This result partially supports the study. FMS skills are expected to be mastered in children up to the age of seven (Gallahue et al., 2012). In ID children, there may be no difference in age due to the delay in the maturation process of movement skills and the heterogeneity of this delay in the sample group. In the study of Simons and Eyitayo (2016), older age groups got better FMS scores than the younger age group. While this difference was greater in the Locomotor skill subtests, it was less in the Object Control skill subtests.

In studies in the literature, it was emphasized that as children with TD grow up, their motor skills also develop (Gallahue & Donnelly, 2003). In the study by Valentini et al. (2016), in the Locomotor and Object Control subtests of children in the 3-10 age group (M = 7.4 years, SD = 1.9), a significant difference was found between age groups.

It appeared that the development of fundamental motor skills in mild intellectual disabled children is insufficient. It will be beneficial for the relevant stakeholders to work together to make the necessary planning to overcome this deficiency.

Conclusion

As a result, this research has shown that both male and female students could not perform FMS at the level of mastery during childhood. It has been determined that male students perform FMS better than female students and age does not have an effect on FMS proficiency. According to this result, low FMS proficiency in the students participating in the study and in the studies reported previously is a major concern. It can be said that the participants did not receive structured game opportunities, adequate training and support to implement the FMS. It points out that with MID children, eliminating lack of FMS mastery, through educational activities given by the teacher and also providing application opportunities at the playground is of prime importance.

Recommendations

In future research, a longitudinal design can be used to provide more knowledge into how ID children's FMS proficiency has changed over time. It is necessary for children to participate in physical activity, to gain body awareness, to develop FMS patterns in the outdoor and to avoid sedentary lifestyle. Educators and parents should devote sufficient time to these skills, give instruction, and encourage children in order to master the movement skills that constitute FMS. FMS's relationship with health, obesity, active lifestyle and physical activity necessitates the active inclusion of FMS education in physical education programs. The scope of the study with a larger sample and students with moderate, severe intellectual disabled students can be expanded.

Limitations

This study was limited to 122 students with mild intellectual disabled only in Kırıkkale province. Anthropometric (Height, weight, BMI) and gross motor skill competence were measured in this study.

Authorship Contribution Statement

M. Ergin: Idea/concept, design, data collection and processing, analysis and interpretation, writing the article. S. Ozbek: Literature review, references and funding.

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