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# Analyzing the selected Eurofit test batteries of the children with Down syndrome and autism in the age range of 12-16 and receiving Montessori education

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**ABSTRACT**

It is aimed in this study to analyze the effects of the Montessori education method on children with Down syndrome and autism having special training who have received and not received Montessori education through the Eurofit test batteries selected for motor skills and physical fitness. A total of 20 male children with Down syndrome and autism in the age range of 12 to 16 and receiving and not receiving Montessori education at two different special education and rehabilitation centers in Kayseri were included in the study. The treatment group included a total of 10 children, 5 with Down syndrome and 5 with autism, and the control group of 10 children, 5 with Down syndrome and 5 with autism. While the volunteers included in the treatment group received Montessori education, those included in the control group received a traditional education. In the study, the volunteers performed the selected Eurofit tests including flamingo balance, plate tapping, sit and reach, handgrip and standing long jump tests. When the results of the Eurofit test batteries of the treatment and control groups were examined, plate tapping and standing long jump test results were found significant in the comparison of the pretest and posttest of the treatment group ($p < 0.05$). In the pretest and posttest comparison of the control group students, a significant difference was determined in the sit and reach test ($p < 0.05$). In the posttest comparison of the control and treatment groups, a statistically significant difference was determined between the pretest and posttest measurements of the plate tapping and between the pretest and posttest measurements of the standing long jump ($p<0.05$). In the pretest comparison of the control and treatment groups, no statistically significant difference was found between the pretest and posttest of flamingo balance, pretest and posttest of plate tapping, pretest and posttest of sit and reach, pretest and posttest of standing long jump and pretest and posttest of handgrip measurements of the control and treatment groups ($p>0.05$). Consequently, the use of Montessori education materials supports the big and small muscle groups of children with disabilities since most of them learn about an object through touch. In our study, when some activity and motor skills of the children with down syndrome and autism in the special rehabilitation school that uses the Montessori education method were analyzed, it was observed that there was an improvement in their physical activities and some motor skills according to the results of plate tapping, standing long jump and sit and reach tests. It is recommended that education programs can be prepared by using Montessori Approach as part of the education programs applied in preschool education institutions and that they can be used more widely together with traditional education programs.

**Keywords:** Montessori, Eurofıt test batteries, down, autism, children.

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## INTRODUCTION

The base of the research of Maria Montessori, who is one of the most important figures in 20th-century education, is the education method that she primarily developed for children with special needs (Cossentino, 2010).

Montessori studied children with special needs and claimed that their improvement could be assisted by special education (Dereli, 2017). Montessori, who believed that children with disabilities could be educated through proper approaches, aimed at addressing the interests of children with special needs, strengthening their motivation, activity training, and improving their social and academic competencies. Montessori materials and education environments offer both diagnostic and therapeutic characteristics. Montessori worked systematically with the materials she developed by performing applications on children with disabilities and changing the materials in accordance with the needs of these children. For instance, she could learn a lot about the inabilities and competencies of the children by observing which materials they chose, which ones they avoid and how they study with the materials in the classroom environment (Nehring-Massie, 2014). As a result of this education program that Montessori applied, it was seen that children with disabilities achieved more than expected (Pickering, 1992).

According to Montessori, children are active and movement is not something apart from the other activities of children. Montessori attached great importance to the freedom of children's movements in the education programs she prepared and she included various exercises regarding the improvement of the movement skills of children with the materials she used. The important thing for her is the actions children perform naturally (Çağlak, 2003). Considering that action and perception are the center of children, actions are important factors playing part in the mental and physical improvements of children with disabilities (Yıldız, 2018). Montessori education method is still used in our country and the world. When the literature is reviewed, it is found that the method is used in our country, as well as abroad, in the education of children who progress normally and those with special needs. Autism, attention deficit and hyperactivity disorder, down learning disability, physical disability and hearing and vision disorders are among the disability types that Montessori education method is used (İlhan Yıldız and Fazlıoğlu, 2020).

Children with autism spectrum disorder can have problems such as spatial awareness, body awareness and disorders in social, communicative and academic abilities and disorder in speech ability. In addition, the existence of obsessive behaviors is also known (İnce, 2017). Various education method is tried for children with autism since they have different characteristics from each other. Many children with autism do not have the ability to study in crowded classrooms. They need to have one-to-one private education (Kavlak, 2019). Therefore, it is recommended to use structured auxiliary education programs that include visual and sensory kinetic stimuli as well as auditory stimuli in the education of children diagnosed with Autism Spectrum Disorder (Tosun and Kurt, 2014). The reality of Montessori can be a hope for both disabled individuals and educators. Since disabled children learn through seeing and touching, material teaching has an important part and an instructional effect (Zakir, 2019).

The Eurofit test battery is a test developed for children and adults for the assessment of generally health-related conformity components (Oja and Tuxworth, 1995). Eurofit tests have been applied to individuals between the age range of 6 to 18 successfully (Mazlumoğlu, 2015). Eurofit tests include components that can measure certain body abilities of children (strength, flexibility, balance, agility and muscle strength). These tests can be adapted to children with disabilities including those intellectually handicapped, and they help to know about the appropriate physical activities for these children. The physical abilities of children reflect their overall lifestyles (Uygun, 2019). Although a flamingo balance instrument is used in the Eurofit test battery, instruments that measure balance more objectively can be preferred. It is aimed in this study to analyze the effects of Montessori education method on children with down syndrome and autism having special training who have received and not received Montessori education through the Eurofit test batteries selected for motor skills and physical fitness.

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## METHOD

### Research model

In this study, the experimental survey model, which is one of the quantitative research methods, was used to achieve the goals determined. Quantitative studies are those that objectify facts and events and reveal and explain them in an observable, measurable and quantitatively expressible way (Creswell, 2012). In order to examine the sports development of individuals receiving Montessori education, some Eurofit tests were preferred, which disabled individuals would not have difficulty doing. In Eurofit tests, some tests that can be done by disabled individuals are preferred. In order to obtain pre-test and post-test measurements, two groups, the experimental group and the control group, were formed in the study, and the pre-test and post-test measurements of both groups were Height and Body Weight Measurements, flamingo balance test, Plate Tapping Test, Sit and Reach Test, Standing Long Jump Test, Handgrip Tests were applied. The pretest measurements of the children participating in the study voluntarily were taken in September of the 2021-2022 academic year. The post-test measurement was taken in

June of the 2021-2022 academic year. It was discussed scientifically if there was a difference between the results of the data through the comparison of pretest and posttest measurements.

**Research group**

The study group of the research included voluntary male children with down syndrome and autism between the age range of 12 and 16 who received and did not receive Montessori education at special education and rehabilitation schools in Kayseri in the 2021-2022 academic year. Treatment and control groups were formed by the random cluster sampling method. The children who could respond to test instructions were selected for treatment and control groups. A total of 20 volunteers, 10 in the treatment group and 10 in the control group, were included in the study. The necessary approval for the study was obtained from the institutions' volunteers were educated in and their parents.

**Data collection tools**

Children with special needs who received and did not receive Montessori education were included in the study and selected Eurofit test battery tests were applied in order to measure the physical fitness of the children. By taking into consideration the necessity of arranging the tests so as not to create tiredness in the children, firstly, height and weight measurements, flamingo balance test and plate tapping test were applied respectively. Then, the children were applied sit and reach test, the standing long jump test and finally handgrip test.

**Statistical analysis**

SPSS 20.0 software was used for the statistical analysis of the data. Shapiro-Wilk, Skewness and Kurtosis values were analyzed for the normality distribution. Next, Independent Samples T-Test was used in the pretest and post-test comparisons of the independent groups and Paired Samples T-Test in the pretest and post-test comparisons of the dependent groups. The level of significance (α) was accepted as 0.5 for all statistical methods.

**Height and body weight measurements**

A measuring tape with a 0.01 cm degree of precision was used for the height measurements of the volunteers. Measurements were taken as the heads were upright position, soles were on the floor, knees were stiff, ankles were contiguous and bodies were upright position while the volunteers were barefoot. The body weights were measured barefoot and with minimal clothes by using a bascule with 0.1 degree of precision.

**Flamingo balance test**

This test was used to measure the general balance of the children. The children were asked to balance on a metal or wooden beam with 50 cm long, 4 cm high and 3 cm wide that was covered with a material. The beam was stabilized by supports with 15 cm long and 2 cm wide. During the exercising the test, the children stood on a preferred foot on the beam, flexed the free leg from the knee towards the back with the help of the hand on the same side and tried to stand like a flamingo. The free hand was used for balance. Thus, children tried to keep balance on the preferred leg. The test started with the instructor letting go of the student's hand. The instructor started the test with a stopwatch after s/he let go of the student's hand and the child tried to keep balance for 1 minute. The exercise continued until the 1 minute was completed. The number of tries for keeping balance for 1 minute was recorded as the test result. For instance, the student who lost his balance 5 times and balanced again during the 1-minute test received 5 points. Since the test required balance on the beam for 1 minute except for falls, the number of tries was recorded for the one who balanced on the beam for 1 minute (Musa, 2020).

**Plate tapping test**

This test, the second of Eurofit tests, is a measurement based on tapping two plates using one preferred hand to assess the movement speed of the extremity. Plastic discs with 20 cm diameter are put on a table suitable for children's height with 60 cm distance from each other's edges. The distance between the center points of the discs should be 80 cm (60 cm from the edges). A 10 × 20 cm rectangle plate is placed between both discs. The instructor starts the stopwatch with the instruction and children move the preferred hand over the other swiftly between the two discs. The instructor stops the stopwatch after the children tap the disc that they first tap 25 times and records the score. Thus, a total of 50 tappings occur in the test. The score is the time period when each disc is tapped 25 times. The best score should be recorded as 1/10 s. For instance, 103 points are obtained in 10.3 s. If children fail to tap, another try is let to reach 25 taps (Çetin, 2019).

**Sit and reach test**

The aim of this test is to measure flexibility. The children were asked to sit and reach forward as far as possible

without bending their legs. There was a test table 35 cm long, 45 cm wide and 32 cm high, and the dimensions of the upper table that was placed on the test table were 55 cm long, 45 cm wide and 35 cm high. The upper table should be placed with its edge being lain 15 cm beyond the place where the subject rested his feet. The surface of the upper table should be divided from 0 cm to 50 cm in the direction of the subject. In the practice performed, the children were asked first to sit and lean their soles against the box. Next, they were asked to stretch their bodies reaching their arms forward to the extreme point they could reach without bending their knees and try to stay still at this point. The children kept their position at the extreme point they could reach for 1-2 s. The best of the two tries is recorded as the result. For example, while the score of the subject who reaches the toes is 15 (15 cm), the subject who reaches 7 cm beyond his/her toes obtains 22 points (22 cm). As a result, the best of the two tries was recorded (Kamar, 2008).

### Standing long jump test

The purpose of this test is to measure the explosive power. The children were asked to jump forward from where they stood without gaining speed. In the practice, children stand just behind the jumping line with their feet together and their toes not crossing the line. The hands are extended backward by bending the knees and they are asked to jump as far as possible by pushing their legs and hurling their arms forward as keeping their position. They are told to try to land on both feet adjoined and standing upright. In order to determine the distance jumped, the distance between the heel marks and the jumping line is measured and the result of each trial is recorded. The best jumping or degree is taken as the score. The results are recorded as cm. For instance, the score of the child who has jumped 1 m 56 cm is recorded as 156 points (Kızılakşam, 2006).

### Handgrip test

A Grip-D hand dynamometer that could measure until 100 kg strength was used in the measurements of hand dynamometer measurement method. Dynamometers were selected in accordance with the sizes of the children's hands for handgrip strength measurement. The children were asked to hold the dynamometer using the active hand with their arms straight and having a 10–15-degree angle from the shoulder and to squeeze as hard as they could following the instructions. In this test, the best value of the two trials is recorded as kg. For instance, 24 points are obtained as the result of the squeezing strength of 24 kg (İri et. al. 2003).

## FINDINGS

Children with special needs who received and did not receive Montessori education were included in the study and selected Eurofit test battery tests were applied in order to measure the physical fitness of the children. The results of the obtained data are given in the tables below.

As shown in Table 1, the age average of the descriptive statistics values of the total 10 children with down syndrome participating in the study is 14.40 ± 1.39 years, height average is 152.10 ± 10.63 cm and body weight average is 54.20 ± 10.18 kg. The age average of the descriptive statistics values of the total 10 children with and autism participating in the study is 14.65 ± 1.36 years, the height average is 168.45 ± 4.28 cm and the body weight average is 62.19 ± 3.09 kg.

**Table 1.** Physical characteristics of participants (Down syndrome and autism participating).

| | Down syndrome (n = 10) | Autism (n = 10) | Minimum | Maximum |
|---|---|---|---|---|
| | $\overline{x}$ ± SS | $\overline{x}$ ± SS | | |
| Age (year) | 14.40 ± 1.39 | 14.65 ± 1.36 | 12 | 16 |
| Height (cm) | 152.10 ± 10.63 | 168.45 ± 4.28 | 132 | 171 |
| Height (kg) | 54.20 ± 10.18 | 62.19 ± 3.09 | 39 | 85 |

While a significant difference was not found between the flamingo balance pretest and posttest, sit and reach pretest and posttest and handgrip pretest and posttest measurements of the treatment group ($p > 0.05$), a significant difference was determined between the plate tapping pretest and posttest and standing long jump pretest and posttest measurements ($p < 0.05$) (Table 2).

When Table 3 was analyzed, it was found that there was no significant difference between the flamingo balance pretest and posttest, plate tapping pretest and posttest and standing long jump pretest and posttest measurements of the control group ($p > 0.05$), a significant difference was determined between the sit and reach pretest and posttest measurements ($p < 0.05$).

As seen in Table 4, no statistically significant difference was determined between the flamingo balance pretest and posttest, plate tapping pretest and posttest, sit and reach pretest and posttest, standing long jump pretest

**Table 2.** Pretest and posttest comparison of the treatment group (Down syndrome and autism participating).

| Variables | | n | X | S.s. | t | P |
|---|---|---|---|---|---|---|
| Flamingo balance | Pretest | 10 | 11.10 | 1.853 | 0.968 | 0.358 |
| | Posttest | 10 | 10.10 | 2.079 | | |
| Plate tapping | Pretest | 10 | 267.70 | 96.767 | 3.325 | 0.009** |
| | Posttest | 10 | 144.10 | 56.300 | | |
| Sit and reach | Pretest | 10 | 18.40 | 2.011 | 0.535 | 0.605 |
| | Posttest | 10 | 17.90 | 3.107 | | |
| Standing long jump | Pretest | 10 | 56.80 | 19.043 | -2.379 | 0.041* |
| | Posttest | 10 | 70.00 | 24.976 | | |
| Handgrip | Pretest | 10 | 7.880 | 3.0622 | -1.546 | 0.156 |
| | Posttest | 10 | 8.820 | 4.1004 | | |

*p<0.05, **p<0.01, ***p<0.001.

**Table 3.** Pretest and posttest comparison of the control group (Down syndrome and autism participating).

| Variables | | n | X | S.s. | t | P |
|---|---|---|---|---|---|---|
| Flamingo balance | Pretest | 10 | 12.60 | 1.430 | 0.089 | 0.931 |
| | Posttest | 10 | 12.50 | 2.718 | | |
| Plate tapping | Pretest | 10 | 320.00 | 96.425 | 0.461 | 0.656 |
| | Posttest | 10 | 298.10 | 124.005 | | |
| Sit and reach | Pretest | 10 | 17.10 | 1.663 | -3.643 | 0.005** |
| | Posttest | 10 | 20.50 | 2.121 | | |
| Standing long jump | Pretest | 10 | 42.70 | 12.553 | 1.406 | 0.193 |
| | Posttest | 10 | 39.30 | 13.217 | | |
| Handgrip | Pretest | 10 | 6.630 | 1.6520 | -1.279 | 0.233 |
| | Posttest | 10 | 6.830 | 1.6228 | | |

*p < 0.05, **p < 0.01, ***p < 0.001.

**Table 4.** Pre-test comparisons of groups with down syndrome and autism participating in the study.

| Variables | | n | X ± S.s. | t | p |
|---|---|---|---|---|---|
| Flamingo balance | Control | 10 | 12.60 ± 1.43 | -2.027 | 0.58 |
| | Treatment | 10 | 11.10 ± 1.85 | | |
| Plate tapping | Control | 10 | 320.00 ± 96.42 | -1.211 | 0.242 |
| | Treatment | 10 | 267.70 ± 96.77 | | |
| Sit and reach | Control | 10 | 17.10 ± 1.66 | 1.575 | 0.133 |
| | Treatment | 10 | 18.40 ± 2.01 | | |
| Standing long jump | Control | 10 | 42.70 ± 12.55 | 1.955 | 0.066 |
| | Treatment | 10 | 56.80 ± 19.04 | | |
| Handgrip | Control | 10 | 6.63 ± 1.65 | 1.136 | 0.271 |
| | Treatment | 10 | 7.88 ± 3.06 | | |

*p < 0.05, **p < 0.01, ***p < 0.001.

and posttest and handgrip pretest and posttest measurements of the control and treatment groups ($p > 0.05$).

As seen in Table 5, while no significant difference was determined between the flamingo balance pretest-posttest, sit and reach pretest-posttest and handgrip pretest-posttest measurements of the control and treatment groups ($p > 0.05$), a statistically significant difference was found between the test measurements of plate tapping and standing long jump ($p < 0.05$).

**Table 5.** Post-test comparisons of groups with down syndrome and autism participating in the study.

| Variables | | n | X ± S.s. | t | p |
|---|---|---|---|---|---|
| Flamingo balance | Control | 10 | 12.50 ± 2.72 | -2.218 | 0.40 |
| | Treatment | 10 | 10.10 ± 2.08 | | |
| Plate tapping | Control | 10 | 298.10 ± 124.00 | -3.576 | 0.002** |
| | Treatment | 10 | 144.10 ± 56.30 | | |
| Sit and reach | Control | 10 | 20.50 ± 2.12 | -2.185 | 0.42 |
| | Treatment | 10 | 17.90 ± 3.11 | | |
| Standing long jump | Control | 10 | 39.30 ± 13.22 | 3.436 | 0.003** |
| | Treatment | 10 | 70.00 ± 24.98 | | |
| Handgrip | Control | 10 | 6.83 ± 1.62 | 1.427 | 0.171 |
| | Treatment | 10 | 8.82 ± 4.10 | | |

*p < 0.05, **p < 0.01, ***p < 0.001.

## DISCUSSION AND CONCLUSION

Montessori method is an education method that supports the cognitive, physical, social and some motor skills of children with special needs and that ensures the increase of their sense of independence and self-confidence. In this study, voluntary male children with autism and down syndrome in the age range of 12 and 16 who received and did not receive Montessori education were divided into two groups, a treatment group and a control group, and they applied some Eurofit tests. The pretest and posttest results of the data obtained from the study were compared and it was scientifically searched if there was a difference between them. Exercises were applied in a way not to force the capacity of the children.

Eurofit tests have been preferred because they provide information about children's attitudes and policies regarding body condition in a very short time, help in the determination of existing health problems, and reveal the weak aspects of physical ability in disabled people. (Levarlet-Joye and Bernard, 1986).It also reveals the reduction of the child's activities in daily life. (Tuxworth, 1986). Eurofit test batteries are tests that can be used for scientific purposes. Allows coaches to evaluate work (Committee of Experts on Sports Research, 1988).

Five different Eurofit tests were applied in the study. Generally, while a statistically significant difference was found between the plate tapping, standing long jump and sit and reach tests measurements in the pretest and posttest comparison of the treatment and control groups, no significant difference was determined between the pretest and posttest measurements of flamingo balance test and handgrip test.

When we examined the findings obtained from the study, it was determined that the test measurements of plate tapping test, which measured the movement speed and basic motoric features of the extremity, and standing long jump test, which measured the explosive power, in the pretest and posttest comparison of the treatment group were significant ($p < 0.05$). In his study, Gültürk (2017) examined the effect of the 12-week movement training (Eurofit test movement training) for male children with autism at different ages on some of their motor skills. It was stated that the posttest scores of the children were higher than the pretest scores and statistically significant in the plate tapping test. When we examined the findings that were the posttest comparisons of treatment and control groups, it was determined that there was a statistically significant difference between the pretest and posttest measurements of plate tapping and standing long jump ($p < 0.05$). Kavlak (2019) found out in her study that she conducted to analyze the effect of the regular physical activity program applied to children with autism on some motoric features, that there was a significant difference in the flamingo balance, sit and reach, standing long jump and handgrip strength test results in the pretest and posttest comparison of the treatment group. In the pretest and posttest comparison of the data of the control group, it was seen that there was no significant difference in flamingo balance, sit and reach,

standing long jump and handgrip strength test results.

In this study, a significant difference was found in the sit and reach test between the pretest and posttest comparison of the control group, which aimed at measuring the flexibility of the children ($p<0.05$). In the study that Kara et. al. (2019) conducted on the physical fitness parameters of basic movement training in children with autism, it was stated that there was a statistically significant difference between pre and post training in terms of the variables of standing long jump, flexibility and vertical jump tests that were applied to children with autism. In addition, when we examined the study by Taner (2020), which was similar to our study, it was determined that there was a significant difference in the pretest and posttest score averages of the standing long jump and flexibility (sit and reach test) measurements applied to male and female individuals with autism at the age range of 16 and 23 in order to determine the effect of sports training on individuals with autism spectrum disorder and its contribution to their social, self-care and academic skills.

In Nalbant's study (2011), which examined the effect of the 14-week physical activity program on the motor development of children with down syndrome in their daily life activities, it was determined that there was no statistically significant difference between the groups as a result of the analysis of the bent arm hang, sit-up, shuttle run and flexibility values ($p > .05$).

It was observed in sit and reach test that flexibility values depended on the joint and muscle structure of individuals and they changed through growing in children. Although it was stated in related studies that the flexibility values of female children were higher when compared to male students (Şahiner and Balcı, 2010), it is believed that the flexibility values of the male children in our study increased because both the children's age and the freedom of movement in the Montessori education approach. In a study, the physical activities of the children receiving Montessori education and those receiving traditional education were analyzed comparatively, and it was determined that children receiving Montessori education were more active (Pate et al., 2014).

In the pretest comparisons of the control and treatment groups, no statistically significant difference was found between the pretest and posttest measurements of the flamingo balance test, plate tapping test, sit and reach test, standing long jump test and handgrip test of the children in the control and treatment groups. This is believed to be due to the homogeneous distribution of the group, the fact that the participants are male volunteers, there is no physical difference between them, and the age range is not very wide.

When the literature is reviewed, it is seen that some studies are similar to our study but others are not. In the literature review, there is a limited number of studies in Turkiye conducted on the motor skill development of children with down syndrome (Çetin, 1995; Kobal, 2000). No study related to the Eurofit test applied to children with down syndrome and autism together was found. Thus, it can be stated that our study is research to shed light on related field studies.

It is stated that Montessori education materials have a very important effect on the education of children with autism and down syndrome since they especially aim to develop some aspects of these children such as basic, physical and motor skills (Zakir, 2019). For this reason, it is very important for children with disabilities to use Montessori educational materials. Since children with disabilities learn most objects through touching, Montessori education materials will provide their mental and social aspects to develop as well as support their major and fine muscles. Consequently, it was observed in this study that development occurred in physical activities and some motor skills of the children with autism and down syndrome educated in the special rehabilitation center applying the Montessori education method in plate tapping test, which assesses the basic motoric features, standing long jump test, which measure the explosive strength, and sit and reach test, which aims to measure the flexibility of the children. In this case, education programs can be prepared by using Montessori Approach as part of the education programs applied in preschool institutions and their effects on children can be searched. It is recommended that Montessori education be used in handicapped centers together with traditional education programs more widely. Other modern approaches can be included in academic studies as well as the Montessori approach.

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