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AN INVESTIGATION OF HAND-EYE COORDINATION, ATTENTION, BALANCE AND MOTOR SKILL IN SCHOOL CHILDREN

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Abstract

The purpose of the present study was to examine the hand-eye coordination, attention, balance and motor skill differences in school children aged 9-10 in terms of gender. A total of 38 children, 21 boys with an average age of 9.9 ± 0.41 years and 17 girls with a mean age of 9.9 ± 0.26 years, participated in the study. Participants performed Two-Arm Coordination Test for hand-eye coordination, Cognitrone for attention, Flamingo-balance test for balance and ball throw test for motor skills. Statistical analyses revealed no significant differences in hand eye-coordination overall scores between boys and girls ($p>.05$). In attention overall scores, boys had higher scores than girls, but this difference was not statistically significant ($p>.05$). The balance test scores also revealed no significant difference between girls and boys ($p>.05$). Boys' motor skill test scores were higher than that of the girls but again this difference was not statistically significant ($t=1.20$, $p=.24$). As a result, it can be said that there is no gender difference in hand-eye coordination, attention, balance and motor skill variables among 9-10-year-old children. Plans can be made with mixed groups in the work to be done on this age group. It is thought that concerted coordination, balance, attention and motor skills training may have a positive effect on this age group in both genders.

Keywords: Coordination, motor skill, attention, balance.

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1. Introduction

Coordination is the ability to make different movements, suitable for the purpose and compatible with each other. In other words, it is a term that defines the purposeful movement in which the skeletal muscles and the central nervous system work in harmony (Muratlı, 2003). Coordination can improve difficult movements in a short time and enable appropriate reactions in situations; watch and perform each movement correctly and with the desired force (Albay et al., 2008).

Coordination with sportive meaning is a nervous force of the organism. Coordination is applied during purposeful, compatible, motivated and involuntary movements (Yıldız, 2007). Motor coordination involves the harmonization of nerve and musculoskeletal systems, resulting in a fast, correct, and balanced motor response assessed by hand-eye or foot-eye coordination measurements (Corbin et al., 2000; Lopes et al., 2012).

Visual motor coordination is defined as receiving visual stimuli and generating appropriate motor answers with mind-body coordination. This is known as eye-hand coordination. The visual-motor coordination skills include: walking, running, jumping, climbing, cooking, dressing, undressing, buttoning, washing hands and face, brushing teeth, cycling, driving, using computer, coloring, reading-writing and using a pair of scissors. In addition, they play a significant role in self-sufficiency and successful school and social life. The development of visual motor coordination in children starts with directing their focus towards various objects within their visual field and using their body and hands (Ercan et al., 2011).

Balance is the ability to maintain a posture, to adapt quickly to postural changes or to move through a sequence of postures, without falling, and constitutes an integral and inevitable component of most movement activities (Burton & Davis, 1992; Kitamura & Matsunaga, 1990). Static balance is the ability of the body to maintain a desired posture in a stationary position, while dynamic balance implies changes in posture (Tsai et al., 2008).

Balance and coordination are the most important steps to complete the basic development process and to ensure that the body control is achieved as required. The development of static balance is a basic characteristic of normal motor development. Most of the developmental motor tests include a measure of static balance (Geuze, 2003).

Attention is one of the most important mental processes for the growth of an individual's knowledge. Attention enables the individual to select various sensory stimuli to acquire skills and to form appropriate behavioural habits. Attention allows the individual to adapt to his/her environment (Hijazi, 2013).

Previous literature has found that in children younger than 10 years, there was no gender difference in terms of physical performance (Thomas & French, 1995; Erikoğlu et al., 2009**)**, and attention (Karaduman, 2004) while some studies indicated that there was a difference in balance (Junaid, & Fellowes, 2006; Holm, & Vøllestad, 2008; Jiang et al., 2018), other motor abilities (Plimpton, & Regimbal, 1992; Janković, 2014).

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2. Problem Statement

There is scarce information on gender differences in hand-eye coordination, attention, balance, and motor skills among 9-10 year olds and this study will provide necessary data for physical educators to plan suitable activities to address this age group.

3. Research Question

This study aimed to identify differences if any between boys and girls in hand-eye coordination, attention, balance, and motor skills

4. Purpose of the Study

The purpose of the present study was to examine the hand-eye coordination, attention, balance and motor skill differences in school children aged 9-10 in terms of gender so that Physical Educators will be able to consider planning education programs specifically to address gender differences.

5. Research Methods

5.1. Participants

The study was conducted with 21 boys and 17 girls all between nine to ten years old. The participants were third and fourth grade students of primary schools in the district of Antalya in Turkey. Convenience sampling was used in selection of schools and classes. Third and fourth grade students (9-10 years) were selected because of relatively steady growth period of this age group (Özer, & Özer, 2004). Two classes (third and fourth grade) with a total of 56 students were selected for the study. The goal of the study was explained to the students and their parents, who read and completed the consent forms to indicate their willingness to participate or to allow their children to do so. A total of 38 students, with parents' approval, participated the study. Permission was requested and granted from the Ministry of Education to conduct the study in these schools.

5.2. Methods

The assessments were conducted at the primary schools. The eye-hand coordination, attention and balance tests were administered in assembly room of the school. The motor skill test was administered in the indoor sports field of the school.

Standing height was measured with a stadiometer. During the measurement, the subject was barefoot, body upright, heels adjacent and head frankfort position. The size of the chin was recorded in cm. Weight was measured to a nearest 0.1 kilogram by using a digital floor scale (Özer, 1993).

The Cognitrone Attention-Concentration Test (COG) is a general ability test that assess attention and concentration among the Vienna test system batteries. It requires noticing the similarities between constantly changing figures within the tests' integrity and reacting rapidly and correctly. Participants are asked to compare the figures on the screen and make a decision about their similarities. Four different figures are displayed on the upper part of the screen, and one figure is displayed on the lower part.

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Participants are asked to press the green button on the panel with their right hand when they understand that the figure on the lower part matches with the figure on the upper part; or otherwise, to press the red button. The total duration of the test is 15 to 20 minutes (Psikotek Consulting, 2012).

The Eye-Hand Coordination Assessment was assessed using the Two Arm Coordination Test. This test was done using the Lafayette Instrument Two-Arm Coordination Tester Model 32532A and the Lafayette Instrument Silent Impulse Counter Model 58024C (Lafayette, 2004). This test assesses the participants' two eye-hand coordination by tracking the star on the test device using a metal pointer with both hands clockwise and counter-clockwise. Whenever the participants deviate from the trace they should track, the stimulant counter records it (Green, 1996).

Overall scores were calculated by using sub scores of Cognitrone (Mean Time of correct rejections, sum of correct rejections, mean time of correct reactions, sum of correct reactions and working time) and by using sub scores of Eye-hand coordination (clockwise time, counter-clockwise time, number of clockwise errors, number of counter-clockwise errors). To calculate overall scores, z and T scores for each dimension were calculated according to gender differences. Then T scores for the tests were converted to hundredths using the formula.

$$Overall\ score = \frac{(\text{Score} - \text{Minimum Score})}{(\text{Maximum score} - \text{Minimum Score}} \ x100$$

To compare attention and eye-hand coordination scores of participants, overall scores were used.

Postural balance control was evaluated using the single-legged Flamingo balance test (Deforche et al., 2003).

Subjects were instructed to stand with their eyes open on one leg on a 1-inch-wide, 1½-inch-high and 20-inch-long bar while the free leg was flexed at the knee joint and held at the ankle joint close to the buttocks. One minute of stance was performed and the number of falls were counted and used as a measure of postural balance (Sundstrup et al., 2010; Helge et al., 2010).

Motor skills of participants was measured with ball throws to target test. The aim of this test is to measure the eye-hand coordination. Tape line, tennis balls, packing tape, and three paperboards in different colours were used for the test. The participant stood behind the line which was drawn 3 m away from the wall. The bottom line of the target was stuck 1.5 m high on the wall. The smallest red square at the center of the target was 10 cm x 10 cm, the blue square on the outer part of the red was 30 cm x 30 cm, and the outermost white square was 60 cm x 60 cm. When the participant hit the red square she got 3 points, the blue square 2 points, and the white square 1 point, and if the participant threw the ball outside of the white square she got zero. The test was repeated twice and the highest score was recorded (Seferoglu et al., 2012).

The statistical analysis of the data was done using SPSS and Excel (Analyses Tool Pack) software. First, descriptive analyses were performed. The normal distribution criteria were determined using the Shapiro-Wilk test since the sample size was under 50. In order to examine gender difference in attention, balance, coordination and motor skills, t-test for normal distributed variables and Mann-Whitney U test for non-normally distributed variables were used. Results are shown as mean ± SD, and for all comparisons $p < .05$ was considered significant.

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6. Findings

Table 01. Age (years), height (cm), weight (kg) and body mass index (BMI) values of sample group.

	Boys (n=21)		Girls (n=17)
	Mean ±SD		Mean ±SD
Age (yr)	9.91±0.42	t=-.29. p=.77	9.94±0.34
Height (cm)	136.96±5.96	t=-1.11. p=.28	139.02±5.38
Weight (kg)	35.86±7.90	Z=-.02. p=.99	36.53±9.77
BMI (kg/m^2)	19.23±3.72	Z=-.87. p=.39	18.01±2.45

The age of the boys participating in the study was 9.91 ± 0.42 yr, the height was 136.96 ± 5.96 cm, the weight was 35.86 ± 7.90 kg and the body mass index was 19.23 ± 3.72 kg/m2. The age of the girls was also found to be 9.94 ± 0.34 yr, the height was 139.02 ± 5.38 cm, the weight was 36.53 ± 9.77 and the body mass index was 18.01 ± 2.45 kg/m2, respectively. There was no significant difference between the variables in terms of gender (p> 0.05). Ages of boys and girls were similar. There were no significant differences in weight, height and BMI between the boys and girls (p>.05).

Table 02. Mean and standard deviation eye-hand coordination, attention, balance and motor skill variables of the sample group.

	Hand-Eye Coordination	Attention	Balance (number of mistake)	Motor Skill
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Boys n=21	73.67±67	69.52±18.71	18.71±5.26	14.67±3.54
	Z=-.10. p=.92	t=.30. p=.77	t=.57. p=.57	t=1.20. p=.24
Girls n=17	72.41±15.06	67.79±16.46	17.82±4.17	13.41±2.76

Table 02 shows the mean and standard deviation values for the error percentage averages of the hand-eye coordination variables of the boys and girls participating in the study.

Statistical analyses revealed no significant differences in hand eye-coordination overall scores between boys and girls (Z=-,10, p=.92). In attention overall scores, boys (69.52±18.71) had higher scores than girls (67.79±16.46) but this difference was not statistically significant (t=.30, p=.77). When the balance test scores were examined, no significant difference between girls and boys (t=.57, p=.57) was detected. Girls (17.82±4.17) had smaller number of falls than the boys (18.71±5.26).

Motor skill test scores of boys (14.67±3.54) was higher than the girls (13.41±2.76) but this difference was not statistically significant (t=1.20, p=.24).

7. Conclusion

The present study examined hand-eye coordination, attention, balance and motor skill variables, on a sample with no significant difference in age, height, weight and BMI variables between boys and girls (p>.05).

Erikoğlu et al. (2009) did not find a significant difference in weight and height variables between 7 and 8 years old boys. Lopes et al. (2012) found no significant difference in BMI between boys and girls in the study of 7175 children aged 6-14 years. These results are similar to our findings.

This study found that boys and girls had similar hand-eye coordination overall scores, and there was no significant difference found in terms of gender ($p > .05$).

While there is no significant difference between the genders in the hand-eye coordination variable in our study, it must be stated that the boys' scores were better than the girls'. When the overall attention scores were examined, no significant difference was found in terms of gender ($p > .05$). When balance variables were examined, there was no significant difference in terms of gender, but it was observed that girls made fewer mistakes ($p > 0.05$). Erikoğlu et al. (2009) stated that there is no difference between the genders in the balance variable according to gender and age groups in children aged 7-12 years.

The present study found that motor skills of boys and girls were similar as no significant differences ($p > .05$) were detected.

In previous studies, gender differences in motor abilities and performance in this age group were not clear. Some studies stated that there were genders differences (Karaduman, 2004; Junaid & Fellowes, 2006), others revealed that there was no difference (Plimpton & Regimbal, 1992; Junaid & Fellowes, 2006; Holm & Vøllestad, 2008; Janković, 2014; Jiang et al., 2018). In our study, boys had better scores in hand-eye coordination, attention and motor skills while girls had better scores in the balance test. As a result of present study, it is suggested that more studies on gender differences in hand-eye coordination, attention, balance and motor skill should be conducted.

The lack of gender differences in coordination, balance, attention and motor skills in 9-10 years old school children may be due to relatively slower growth and development characteristics of this age group.

The main limitations of present study was sample size. In future studies, larger sample sizes should be considered. Additionally, in the present study social, environmental and cultural backgrounds of participants were not controlled.

8. Implications

Although the results of this study show a lack of gender differences in coordination, attention, balance and motors skills, physical education teachers, coaches and researchers should still be aware of gender differences (boys outperformed the girls in all the tests except balance) when planning programs to develop the motor skills of children aged nine and ten years of age. This study may provide essential information to plan physical education programs for this particular age group, as coordination, balance, attention and motor skills training may have a positive effect on this age group in both genders. Furthermore, this age group is old enough to be oriented towards sport performance so it is imperative that activities to develop motor skills are emphasized in physical education programs.

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