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Evaluation of Basic Badminton Training Program Applied to 10-12 Age Group Girls with Eurofit Test Battery

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Abstract

Objectives: This study aims to evaluate the effects of the 8-week badminton basic training program on the biomotor characteristics of 10-12 age group girls with the Eurofit test battery.
Methods: The research was carried out on female students between the ages of 10 and 12 who are in the badminton training program within the Youth and Sports Provincial Directorate in Konya. A total of 33 female students, consisting of the badminton training group (experiment; n=18) and the control group (n=15), who did not participate in any sports training program during the study, participated in the study. The duration of the study was completed by planning as 8 weeks. The badminton basic training program was applied to the application group 3 days a week for 60 minutes. Tests and measurements were carried out with the Eurofit Test Battery to evaluate the biomotor characteristics of the participants before and after the badminton training. The data obtained were analyzed using the SPSS 24.0 program. The statistical significance level was accepted as $p<0.05$.
Results: As a result of the study, between the pre-test and post-test mean values of the application group participants; there was a statistically significant difference ($p<0.05$) in favor of the application group in the test parameters of height, flamingo balance, plate tapping, sit-reach, standing long jump, vertical jump, handgrip, bent arm hanging and 10*5 m agility test parameters. Also, it was determined that there was a statistically significant difference ($p<0.05$) in the flamingo balance, plate tapping, sit-reach, and bent arm hanging parameters between the post-test mean values of the application and control groups.
Conclusion: As a result, it can be said that the badminton basic education program applied for 8 weeks has positive effects on the biomotor characteristics of girls aged 10-12.
***Key Words**: Badminton, Physical development, Performance evaluation*

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INTRODUCTION

Today, the cause of many diseases is seen as a sedentary lifestyle. Developing technology imprisons many children in the developmental age at home, and children become victims of a sedentary life. When they reach adulthood, they adapt to an inactive lifestyle and must contend with the diseases that come with it.

Movement is very important for a child's physical development. Physical activity participation in childhood has many positive effects. Among these, positive effects such as better growth and development, an active lifestyle, reducing the risks of future diseases, and preventing excessive weight gain can be demonstrated. In this context, children's participation in some activities that include physical activity is as important for the physical development of children as doing regular sports (Çelik and Şahin, 2013). There are many sports branches that children and young people can do. Badminton is one of the few individual sports in which there is no contact with the opponent (Yüksel, 2018a). Badminton is also one of the most popular racket sports in the world, and it can be easily played for competition or recreation by people of all ages and abilities (Sucharitha et al., 2014; Yüksel, 2018b; Özgür and Hotaman, 2020). Badminton can be played outdoors as well as being an indoor sport. Because of this feature, badminton has an important quality for public health and movement needs.

Examining the physical parameters of individuals both in childhood and later periods is very important for both talent selection and bio-motor development to occur in a positive and timely manner (Yüksel and Aydos, 2019). Furthermore, evaluating physical fitness in children and adolescents allows personal health to be gained early. In this sense, the habit of physical activity and exercise, along with the person's physical fitness, gains importance throughout life (Bilim et al., 2016). As a result of the research carried out under the auspices of the Council of Europe Sports Development Committee, the "Eurofit Test Battery" was developed to determine the physical fitness, physiological function, and motor performance of school-aged children and young people between the ages of 6-18. EUROFIT is the result of many internationally coordinated studies that can be used in research to define and evaluate physical ability in children. (Şipal, 1989).

In the extant literature findings, many studies evaluate different age groups, both in badminton and different sports branches, and individuals with sedentary lifestyles (Uzuncan, 1991; Ziyagil et al., 1996; Loğoğlu, 2002; Erikoğlu et al., 2009; Yüksel, 2017; Yüksel and Aydos, 2018; Aktansoy and Kırmızıgil, 2020; Asma and Işık, 2020). However, no research has been found that evaluates the development of bio-motor abilities of children in the 10-12 age

group who received badminton training with the Eurofit Test Battery. In this respect, it is thought that the findings of this research will contribute to the relevant literature.

This study aims to evaluate the effects of the 8-week basic badminton training program on the bio-motor characteristics of 10-12 age group girls with the Eurofit test battery.

METHOD

The research was designed as a pre-test-post-test control group design, one of the real experimental models. The symbolic view of the research design can be explained as follows:

		Pre-test		**Post-test**
G_D	R	$O_{1.1}$	X	$O_{1.2}$
G_K		$O_{2.1}$		$O_{2.2}$

(G_D: Badminton training trial group**;** **G_K:** Control group**;** **R:** Participants were assigned to groups impartially**;** **$O_{1.1}$ ve $O_{1.2}$:** Pre-test and post-test measurements of the experimental group**;** **$O_{2.1}$ ve $O_{2.2}$:** Pre-test and post-test measurements of the control group**;** **X:** Independent variable applied to the trial group (basic badminton training))

In the research design, the dependent variable is the bio-motor characteristics of girls aged 10-12. In contrast, the independent variable is the basic badminton training program applied for three days a week and eight weeks.

Participants

The research was conducted on female students between the ages of 10-12 in the badminton training program within the Youth and Sports Provincial Directorate in Konya. A total of 33 female students, consisting of the badminton training group (n=18, average age; 11,2) and the control group (n=15, average age; 11,4) who did not participate in any sports training program during the study, participated in the study. It was sought that the children included in the study group did not regularly participate in any sportive activity and that there was no objection to their participation in movement training in terms of health.

Data Collection

For the research, Ethics Committee approval was obtained from the Necmettin Erbakan University Meram Medical Faculty Non-Pharmaceutical and Medical Device Research Ethics Committee, with the decision numbered 2020/2364 stating that there is no objection to the implementation of the study. In addition, a permission certificate from the Konya Provincial Directorate of Youth and Sports and necessary consent from the participants and their families were obtained. A basic badminton training program was applied to the application group for 60 minutes, three days a week, with 10 minutes of warm-up. Then, tests and measurements were carried out with the Eurofit Test Battery to evaluate the bio-motor

characteristics of the participants before and after the badminton training. The pre-tests of the participants in the experimental and control groups were carried out in the first week of January 2020, and the post-test measurements were carried out in the first week of March 2020. Care was taken to carry out the tests and measurements at the same time of day. It was ensured that the participants participated in the tests and measurements in sportswear (shorts, t-shirt, sports shoes, etc.).

Height, body weight, body mass index (BMI), and 30-second sit-up test were determined according to the method reported by Zorba and Saygın (2009). The measurement method reported by Tsigilis et al. (2002) was used for the flamingo balance test. The plate tapping test, the 10x5 meter shuttle run test, and the determination of standing long jump length were applied according to the recipe made by Adam (1988). Sit and reach, Counter Movement Jump test, hand grip strength, and 20 m shuttle run tests were done exactly as explained by Günay et al. (2013). The method reported by Şipal (1989) for the bent-arm suspension test was used.

Statistical analysis

The collected data was analyzed using the SPSS 24.0 (Statistical Package for Social Science) program. Minimum, maximum, arithmetic mean, and standard deviation values are calculated and given. Since the number of female participants in the experimental and control groups was less than 30, nonparametric tests were applied. The difference between the pre-test and post-test mean values of the participants in the application and control groups was analyzed with the "Wilcoxon Signed Ranks Test." Additionally, the determination of the differences between the mean values of the experimental and control groups was analyzed with the "Mann-Whitney U Test." The statistical significance level was accepted as $p<0.05$.

RESULTS

In this section, the comparison of the pretest and posttest scores of the experimental and control group participants is presented. In addition, comparisons between the performance values between groups are presented.

Table 1. Pre-test and Post-test mean values of the experimental group

Variables	Pre-test (n= 18)			Post-test (n= 18)		
	Min	**Max**	**X±SD**	**Min**	**Max**	**X±SD**
Age	10,1	12,1	11,1±0,7	10,2	12,3	11,3±0,7
Height (cm)	129,0	160,0	147,8±7,6	130,0	160,0	148,3±7,3
Body weight (kg)	27,0	59,0	40,8±8,6	28,0	58,0	41,0±8,2
BMI (kg/m^2)	14,8	25,2	18,5±3,1	14,9	24,7	18,5±2,9
Flamingo balance (number)	9,0	18,0	14,5±2,5	8,0	16,0	12,6±2,1
Plate tapping (sec)	11,1	18,4	14,2±2,2	10,9	17,6	13,2±1,6
Sit and reach (cm)	3,0	31,0	19,3±8,0	4,0	31,0	22,2±5,8
Standing long jump (cm)	96,0	180,0	125,8±22,5	101	184	128,1±21,5
Vertical jump (cm)	18,0	34,0	24,0±4,8	19,0	37,0	26,1±4,6
Hand grip strength (kg)	11,0	26,0	16,5±4,2	14,0	28,0	18,9±3,9
Bent arm hanging (sec)	1,3	19,4	9,0±5,0	2,2	20,1	13,4±3,8
30-sec sit-up (number)	3,0	22,0	13,3±4,9	4,0	23,0	13,2±4,4
10x5 m shuttle run (sec)	19,2	28,8	21,6±2,5	19,1	27,5	20,6±1,8
20 m shuttle run (number)	17,0	39,0	27,7±7,5	19,0	40,0	30,4±6,2

Table 1 shows the pretest and posttest minimum, maximum and standard deviation mean values of the experimental group.

Table 2. Experimental group pre-test – post-test Wilcoxon Signed-Ranks test results

Variables		n	Mean rank	z	p
Height (cm)	Pre-test	18	0,00	-2,460	**0,014***
	Post-test	18	4,00		
Body weight (kg)	Pre-test	18	3,50	-1,633	0,102
	Post-test	18	3,50		
BMI (kg/m^2)	Pre-test	18	6,67	-0,280	0,779
	Post-test	18	3,20		
Flamingo balance (number)	Pre-test	18	8,00	-3,451	**0,001***
	Post-test	18	0,00		
Plate tapping (sec)	Pre-test	18	10,07	-3,053	**0,002***
	Post-test	18	4,00		
Sit-reach (cm)	Pre-test	18	3,50	-2,722	**0,006***
	Post-test	18	7,64		
Standing long jump (cm)	Pre-test	18	10,00	-2,425	**0,015***
	Post-test	18	9,40		
Vertical jump (cm)	Pre-test	18	,00	-3,590	**0,000***
	Post-test	18	8,50		
Hand grip strength (kg)	Pre-test	18	,00	-3,804	**0,000***
	Post-test	18	9,50		
Bent arm hanging (sec)	Pre-test	18	1,00	-3,680	**0,000***
	Post-test	18	10,00		
30-second sit-up (number)	Pre-test	18	7,90	-0,042	0,967
	Post-test	18	5,50		

10x5 m shuttle run (sec)	Pre-test	18	9,57	-3,173	**0,002***
	Post-test	18	4,75		
20 m shuttle run (number)	Pre-test	18	9,80	-1,592	0,111
	Post-test	18	9,38		

***p<0,05**

When Table 2 is examined, it is seen that there is a statistically significant difference (p<0.05) between the pre-test and post-test mean values of the experimental group participants in the test parameters height (z=-2,460), flamingo balance (z=-3,451), plate tapping (z=-3.053), sit-reach (z=-2.722).), standing long jump (z=-2,425), vertical jump (z=-3.590), hand grip strength (z=-3,804), bent arm hanging (z=-3.680), and 10x5m shuttle run (z=-3,173), while there is no statistically significant difference (p>0.05) in other parameters.

Table 3. Pre-test and post-test mean values of the control group

Variables	Pre-test (n= 15)			Post-test (n= 15)		
	Min	**Max**	**X±SD**	**Min**	**Max**	**X±SD**
Age	10,2	12,5	11,4±0,7	10,3	12,6	11,5±,7
Height (cm)	130,0	161,0	148,4±8,0	130,0	161,0	148,7±8,0
Body weight (kg)	28,0	57,0	42,2±8,0	28,0	56,0	42,4±7,9
BMI (kg/m^2)	14,9	23,4	19,0±2,6	14,7	23,1	19,1±2,6
Flamingo balance (number)	11,0	18,0	14,0±2,2	11,0	17,0	14,3±1,9
Plate tapping (sec)	11,8	18,2	14,5±2,1	11,9	18,1	14,6±2,1
Sit-reach (cm)	2,0	30,0	18,4±7,7	1,0	29,0	17,7±6,9
Standing long jump (cm)	91,0	175,0	132,1±21,0	100,0	181,0	133,2±21,0
Vertical jump (cm)	12,0	35,0	24,4±5,5	13,0	36,0	25,0±5,4
Hand grip strength (kg)	12,0	30,0	18,4±4,8	14,0	32,0	19,5±4,5
Bent arm hanging (sec)	1,0	17,2	9,2±4,8	1,4	16,9	9,4±4,8
30-second sit-up (number)	5,0	20,0	13,6±3,5	5,0	23,0	14,0±4,2
10x5 m shuttle run (sec)	19,8	26,7	21,5±2,1	19,7	25,5	21,0±1,7
20 m shuttle run (number)	18,0	38,0	29,5±6,2	19,0	39,0	29,6±6,0

Table 3 shows the pretest and posttest minimum, maximum and standard deviation mean values of the control group.

Table 4. Control group pre-test – post-test Wilcoxon Signed-Ranks test results

Variables		n	Mean rank	z	p
Height (cm)	Pre-test	15	,00	-2,000	**0,046***
	Post-test	15	2,50		
Body weight (kg)	Pre-test	15	3,50	-1,633	0,102
	Post-test	15	3,50		
BMI (kg/m^2)	Pre-test	15	3,00	-1,274	0,203
	Post-test	15	8,00		

Flamingo balance (number)	Pre-test	15	1,50	-0,743	0,458
	Post-test	15	3,50		
Plate tapping (sec)	Pre-test	15	8,29	-0,114	0,910
	Post-test	15	7,75		
Sit-reach (cm)	Pre-test	15	7,44	-0,992	0,321
	Post-test	15	6,30		
Standing long jump (cm)	Pre-test	15	7,13	-0,825	0,409
	Post-test	15	6,19		
Vertical jump (cm)	Pre-test	15	,00	-2,271	**0,023***
	Post-test	15	3,50		
Hand grip strength (kg)	Pre-test	15	,00	-2,555	**0,011***
	Post-test	15	4,50		
Bent arm hanging (sec)	Pre-test	15	6,80	-1,477	0,140
	Post-test	15	8,60		
30-second sit-u (number)	Pre-test	15	6,25	-1,224	0,221
	Post-test	15	4,64		
10x5 m shuttle run (sec)	Pre-test	15	8,07	-3,010	**0,003***
	Post-test	15	7,00		
20 m shuttle ru (number)	Pre-test	15	8,00	-0,358	0,720
	Post-test	15	4,43		

***p<0,05**

When the pre-test and post-test mean values of the control group participants were examined in Table 4, it was identified that there was a statistically significant difference ($p<0.05$) in test parameters ($z=-2,000$), vertical jump ($z=-2,271$), hand grip strength ($z=-2,555$) and 10x5m shuttle run ($z=-- 3,010.$) But there is no statistically significant difference ($p>0.05$) in other parameters.

Table 5. Pre-test Mann-Whitney U analysis results of the experimental and control groups

Variables	Group	N	Mean rank	U	p
Age	Experiment	18	15,03	99,500	0,198
	Control	15	19,37		
Height (cm)	Experiment	18	16,28	122,000	0,637
	Control	15	17,87		
Body weight (kg)	Experiment	18	16,03	117,500	0,526
	Control	15	18,17		
BMI (kg/m^2)	Experiment	18	15,83	114,000	0,448
	Control	15	18,40		
Flamingo balance (number)	Experiment	18	18,06	116,000	0,488
	Control	15	15,73		
Plate tapping (sec)	Experiment	18	16,33	123,000	0,664
	Control	15	17,80		
Sit-reach (cm)	Experiment	18	17,56	125,000	0,717
	Control	15	16,33		

Standing long jump (cm)	Experiment	18	15,36	105,500	**0,046***
	Control	15	18,97		
Vertical jump (cm)	Experiment	18	15,97	116,500	0,502
	Control	15	18,23		
Hand grip strength (kg)	Experiment	18	15,17	102,000	**0,031***
	Control	15	19,20		
Bent arm hanging (sec)	Experiment	18	16,61	128,000	0,800
	Control	15	17,47		
30-second sit-up (number)	Experiment	18	16,44	125,000	0,716
	Control	15	17,67		
10x5 m shuttle run (sec)	Experiment	18	17,06	134,000	0,971
	Control	15	16,93		
20 m shuttle run (number)	Experiment	18	16,22	121,000	0,611
	Control	15	17,93		

***p<0,05**

When Table 5 is examined, there is a statistically significant difference between the pre-test mean values of the experimental and control groups in the standing long jump (U=105,500, p<0.05) and hand grip strength (U=102,000, p<0.05) parameters. It was determined that there was no statistically significant difference in other parameters.

Table 6. Post-test Mann-Whitney U analysis results of the experimental and control groups

Variables	Group	N	Mean rank	U	p
Age	Experiment	18	15,67	111,000	0,383
	Control	15	18,60		
Height (cm)	Experiment	18	16,56	127,000	0,772
	Control	15	17,53		
Body weight (kg)	Experiment	18	16,08	118,500	0,550
	Control	15	18,10		
BMI (kg/m^2)	Experiment	18	15,92	115,500	0,481
	Control	15	18,30		
Flamingo balance (number)	Experiment	18	13,94	80,000	**0,044***
	Control	15	20,67		
Plate tapping (sec)	Experiment	18	13,92	79,500	**0,045***
	Control	15	20,70		
Sit-reach (cm)	Experiment	18	20,44	73,000	**0,024***
	Control	15	12,87		
Standing long jump (cm)	Experiment	18	15,67	111,000	0,385
	Control	15	18,60		
Vertical jump (cm)	Experiment	18	17,81	120,500	0,598
	Control	15	16,03		
Hand grip strength (kg)	Experiment	18	16,44	125,000	0,716
	Control	15	17,67		

Bent arm hanging (sec)	Experiment	18	20,11	79,000	**0,043***
	Control	15	13,27		
30-second sit-up (number)	Experiment	18	15,92	115,500	0,478
	Control	15	18,30		
10x5 m shuttle run (sec)	Experiment	18	16,17	120,000	0,587
	Control	15	18,00		
20 m shuttle run (number)	Experiment	18	17,42	127,500	0,785
	Control	15	16,50		

***p<0,05**

When the test mean values of the test and control group participants were examined in Table 6, it was identified that there was a statistically significant difference in flamingo balance (U=80,500, p<0.05), plate tapping (U=79,500, p<0.05), sit-reach (U=73,000, p<0.05), and bent arm hanging (U=79,000, p<0.05) parameters. But there is no statistically significant difference in other parameters.

DISCUSSION

This study was carried out to evaluate the effects of a badminton basic training program applied for eight weeks on the bio-motor characteristics of 10-12 age group girls with the Eurofit test battery.

In the current study, it is determined that there is a statistically significant difference (p<0.05) between the pre-test and post-test mean values of the participants in both the experimental group participating in the badminton training program and the control group. In contrast, no statistically significant difference is observed in the mean weight and body mass index values. Therefore, although a limited increase is noted in the body weight parameter, it is thought that the differences in height are especially due to the rapid physical development of children.

When the balance results are examined, a significant difference is observed between the experimental group participants' pre-test and post-test mean values. In contrast, no difference was found in the control group. In addition, while the pre-test mean values of the participants in the experimental and control groups are similar, significant differences are found between the post-test mean values in favor of the experimental group. It can be argued that this situation is caused by the effect of the badminton training program. It can be stated that the arm other than the racket arm is actively used to balance the body during training and teaching of basic techniques; it is necessary to have a good body balance between applying the right techniques in every part of the game, and thus it is the result of the exercise carried out. Gerime (2003) found the average value of the flamingo balance test as 11.75 in his study on measuring

the physical fitness of 9-12-year-old students with the Eurofit test battery. While Tınazcı and Emiroğlu (2009) stated the average value of the flamingo balance test as 14, Berisha (2018) reported the average value of the flamingo balance test as 11.9 in girls and 11.8 in boys among 11-year-old students in Kosovo. Therefore, it can be asserted that the values obtained in the present study are generally compatible with the literature.

When the test results of plate tapping are examined, it is seen that there is a statistically significant difference (improved) between the pre-test and post-test mean values of the experimental group participants ($p<0.05$). Baydil (2006) determined the arm movement speed as 13.18 seconds in his study to investigate the physical fitness norms of 12-14 male students in the Kastamonu Region using Eurofit Tests. Sharp et al. (2016) stated that the average values of the touching the discs test in tennis players with an average age of 11.61 were 11.80 seconds and 11.69 seconds, respectively, in the pre-test and post-tests. Erikoglu et al. (2009) found a statistically significant difference between age groups in 7-12-year-old female and male participants. However, there was no gender difference in the values of touching the discs ($P<0.05$). In his study, Berisha (2018) reported the mean values of the plate tapping test as 12.76 seconds in girls and 14.45 seconds in boys. Again, in the same study, European countries stated the average values of the plate tapping test as 14.01 seconds for girls and 14.46 seconds for boys. The available literature findings support the findings obtained in the current study.

When the sit-reach test results are examined, it is determined that there is a statistically significant difference ($p<0.05$) between the experimental group participants' pre-test and post-test mean values. In addition, while the pre-test mean values of the participants in the experimental and control groups are similar, significant differences are found between the post-test mean values in favor of the experimental group ($p<0.05$). Therefore, it can be said that the applied badminton training program improves the athletes' flexibility. Mazlumoğlu (2015) found that the female students engaged in sports activities achieved more successful results from this test in his study. In his research, Mazlumoğlu compared the physical characteristics of girls and boys between the ages of 10-12 who are actively involved in sports with those who are not actively involved in sports by applying the Eurofit tests. Another study (Başal and Yüksel, 2021) determined it as 20.2 cm at 12. Therefore, it can be argued that the current literature findings are partially parallel to the current research results. The flexibility of both upper and lower extremities and trunk muscles in badminton sports provides athletes with many advantages. The joint's range of motion and the muscles' flexibility play an important role in not losing control, especially in performing a technical movement and in difficult positions such as overhead strikes that the player may encounter during rallies in the game. In this respect, the

movements applied during the mentioned badminton training are expected to show positive developments in the flexibility parameter.

When the standing long jump test results are examined, it is determined that there is a statistically significant difference ($p<0.05$) between the experimental group participants' pre-test and post-test mean values. In Mazlumoğlu's (2015) study, results were obtained in favor of the students who do sports, based on the standing long jump average values of male and female students who do and do not. In Gerime's (2003) studies and Kalkavan et al. (2005), the standing long jump average values vary between 131-136 cm and are similar to the findings obtained in this study.

When the vertical jump test results are examined, it is determined that there is a statistically significant difference ($p<0.05$) between the experimental group participants' pre-test and post-test mean values. Vertical jump average values of male national and amateur badminton players with an average age of 11 were determined to be 31.70 cm in national badminton players and 27 cm in amateur-level badminton players (Kafkas et al., 2009). In their study on 22 basketball players (10.5 years old), Kalkavan et al. (2005) showed the vertical jump average value as 24.31 cm, while in another study on 9-10 age group girls, Mondal (2006) reported the vertical jump average value as 24.82 cm. Katie et al. (2003) found significant increases in the vertical jump values of children who received sports training compared to children who did not. Therefore, it can be argued that the relevant studies are generally compatible with the current research results. The increase in the mean values of the participants in the experimental group may be a result of the positive effect of the applied badminton training.

When the hand grip strength test results are examined, it is determined that there is a statistically significant difference ($p<0.05$) between the experimental group participants' pre-test and post-test mean values . In Kızılakşam's (2006) study, there was no difference between male students in terms of right and left-hand grip strength test results, but it was seen that female students doing sports had higher hand grip strengths. Mazlumoğlu's (2015) study showed no statistically significant difference between the groups regarding hand grip strength tests regarding male and female students who do and do not do sports. Karacabey et al. (2016) determined the mean values of right-hand grip strength as 15.27 kg and the mean values of left-hand grip strength as 15.29 kg in their study. Many studies in the literature stated that there is an increase in hand grip strength in children with participation in sports and exercise activities (Katie et al., 2003; Asma and Işık, 2020; Erdağı et al., 2020). Therefore, it can be argued that the literature results generally overlap with the findings of this study. The fact that a significant

difference was found in the dominant hand grip strength values of the experimental group in the study can be explained by working with the racket many times in badminton training. In addition, it can be considered a result of special studies to improve hand grip strength due to the necessity of gripping the racket more tightly in some technical strokes (smash, drive, net-kill) in badminton.

When the results of the 30-second sit-up test are examined, it is determined that there is no statistically significant difference between the participants' pre-test and post-test mean values ($p>0.05$). In his study, Berisha (2018) determined the average value of the 30-second sit-up test of 11-year-old girls as 15. Mazlumoğlu's (2015) study revealed that male and female students who do sports are more successful in sit-up tests than students who do not. In a similar study, Kızılakşam (2006) revealed that female students who do sports are more successful in the 30-second sit-up test. Therefore, it can be said that the relevant studies are consistent with the research results. On the other hand, contrary to the findings of the present study, in another study conducted among the sports branches in which children between the ages of 9-11 are engaged, the average value of 30-second sit-up was determined as 25.3 in badminton players, 21.7 in tennis players, 22.6 in football players, 23.7 in swimmers. 22.9 in karate players, 19.8 in volleyball players, 22.1 in hockey players, and 24.7 in gymnastics (Opstoel et al., 2015). It is seen that the results of this research have better values than the findings of the current study. In general, it is noted that the average values obtained according to the literature review coincide with the results of the research. Still, it has been found that it is lower than the values obtained in some studies. This may be because the children in the selected groups had low trunk endurance and did not do enough abdominal strength exercises in their training programs.

When the bent arm hanging test results are examined, it is determined that there is a statistically significant difference ($p<0.05$) between the experimental group participants' pre-test and post-test mean values. In addition, while the pre-test mean values of the participants in the experimental and control groups were similar, significant differences were found between the post-test mean values in favor of the experimental group ($p<0.05$). When the literature is reviewed, there are many studies on different sports branches and on students who do or do not do sports. For example, Tınazci et al. (2004) showed the mean values of the 7-11 age group bent arm hanging test to be 4.61 seconds and 3.26 seconds for boys and girls, respectively, while in another study, it has been reported as 8.93 seconds for boys and 4.92 seconds for girls in the 8-11 age group. In the study of Loğoğlu (2002), on the other hand, it was determined that the average value of the bent arm hanging test in 12-year-old girls was 15.56 seconds. Therefore, it is reported that the findings obtained in the current study are in parallel with the

results of the study of Loğoğlu (2002), while the results of Tınazcı et al. (2004) are quite high compared to the results of the research. This may be due to the small age differences between the study groups. In addition, as stated in the test protocol, it may result from observer differences in the detection of the participant's eye level falling below the pull-up bar during the test. Indeed, it is expected that the experimental group participants will show significant improvement after eight weeks of training as a result of performing multiple hits with the racket and actively using the upper extremity in badminton sports, and this can be seen as a result of the sport's characteristic features.

When the 10x5 m shuttle run test results are examined, it is determined that there is a statistically significant difference ($p<0.05$) between the experimental group participants' pre-test and post-test mean values. When the literature was reviewed, Berisha (2018) reported the average values of the 10x5 m shuttle-run-test in girls aged 11 and 12 as 22.4 seconds and 22.7 seconds, respectively. In another study conducted by Aydın (2019) on male football players aged 11-13, the mean values before and after football-specific functional exercises were determined as 21.8 seconds and 21.3 seconds, respectively. In another study, Uzuncan (1991) determined the 10x5 m shuttle run test results of 12-year-old male students as 24.9 seconds. In addition, Ziyagil et al. (1996) and Kızılakşam (2006) stated that boys and girls who do sports are more successful in 10x5 m shuttle run tests. Therefore, it can be argued that the findings obtained in the studies are compatible with the current research results.

When the 20 m shuttle run test results are examined, it is determined that there is no statistically significant difference between the pre-test and post-test mean values of the participants in the experimental and control groups ($p>0.05$). However, it was determined that the post-test mean values of the participants in the experimental group improved according to the pre-test results. When the literature was examined, Güler et al. (2010) stated that the 20 m shuttle-run-test average values of the football players playing in the top three teams in the provincial championship competitions among primary schools were determined as 26.5. The 20 m shuttle-run-test average value of the football players playing in the eliminated or the last place teams was 20.2. In another study conducted on sixth-grade middle school students, it was reported that the average value of 20 m shuttle run of female students was between 27 and 29 in the control and experimental groups (Başal and Yüksel, 2021). As a result, the findings of this study are consistent with the research findings. There are, however, studies that contradict the research findings. For example, Tınazcı and Emiroğlu (2009), in their study on children aged 9-11, determined the average number of 20 m shuttle runs for children aged 10 and 11 living in rural areas as 36.4 and 41.1, respectively. They stated that the average values of the

20 m shuttle run of children aged 10 and 11 living in urban areas were 33.5 and 38.1, respectively. In Berisha's (2018) study, it is reported that the mean values of girls aged 11 and 12 are lower than the findings of the current study. These differences can be explained by the pace of motor skills development, such as endurance changes, especially in the participatory groups in the developmental age.

CONLUSIONS

As a result, it has been determined that the badminton basic education program applied for eight weeks positively affects the bio-motor characteristics of girls in the 10-12 age group.

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