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RESEARCH ARTICLE

Investigation of the Effects of Circuit Training in Unit Training in Wrestlers Aged 11-13

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Abstract
The aim of this research is to examine the effect of circuit strength training applied to wrestlers aged 11-13 on body composition and fluid balance in unit training. 20 male wrestling athletes with an average age of 11.44±1.15 years and an average height of 147.45±11.68 cm, who regularly perform their training in Davraz Sports Club and participate in circuit strength training at least once in these trainings, voluntarily participated in our research provided. Body composition values of the athletes were performed with the Inbody-720 bioelectrical impedance analyzer in accordance with the test protocols.Pre-post test measurements of body weight, total body water, body fat weight, protein, mineral, body fat ratio, BMI, skeletal muscle weight, visceral fat level, waist-hip ratio and in-body score of the athletes participating in our research were performed.In our study, there was no statistically significant difference in body fat weight, total body water, body fat ratio, protein, mineral, skeletal muscle weight, visceral fat level, BMI, in body score ($p>0.05$), but waist hip ratio. and body weight values were found to be significantly different ($p<0.01$). As a result of our study, it was determined that circuit strength training applied to wrestlers between the ages of 11-13 had positive effects on some body parameters measured by Bioelectrical Impedance technology and statistically significant changes occurred.

Keywords
Wrestling, Circuit, Training, Inbody

INTRODUCTION

Wrestling sports are mostly used anaerobic energy sources, strength, speed, endurance, coordination, flexibility, experience, etc. It is a combat sport where factors directly affect performance (Akgün, 1992; Akyüz, 2009; Aydos et al. 2009; Cisa et al. 1987; Johnson and Cisar, 1987).

Wrestling is the struggle of two athletes against each other by using their maximal performances within a certain period of time without using equipment and tools, without going out of the field, and bringing the opponent's back to the ground (Açak et al. 1997). In wrestling, very quick and sudden movements are made in a short time. For this reason, aerobic power and anaerobic power are very important in wrestling. Success in wrestling mostly depends on body strength. The strength of the athlete is of great importance in defense and attacking the opponent.

At the same time, it is important in countering the opponent's technique and applying the tactical technique against it (Agaoglu et al. 2010).The aerobic and anaerobic capacities, strength, speed, flexibility and endurance characteristics of wrestlers directly affect their performance, and in order to achieve success, these

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characteristics must be reached to higher levels with appropriate training programs.Therefore, branch-specific strength training programs should be applied starting from childhood, taking into account the developmental periods, physiological and mental characteristics (Bağcı, 2016). The strength factor is one of the basic biomotoric characteristics of the athlete, and it is the ability to move a mass, overcome resistance or counteract with muscle power by voluntary contraction of the muscles. Strength is of great importance in revealing the sportive efficiency at the highest level and preventing possible injuries (Hatfield et al. 2006). The type of training called "Circuit-Training" in the field of sports sciences is expressed as circular training in our country.

Circular training consists of time-limited exercises performed one after the other, with different rest periods between exercise stations, transitioning to the next after each exercise station (Gambetta, 2004). Circuit training method is a training method that is carried out to increase the performance of the conditional properties and the performance of the strength continuity feature (Scholich, 2011). Circuit training; It is a form of conditioning training that includes endurance, strength, high-intensity aerobics and exercises similar to interval training. Strength development targets strength and muscular endurance. One set includes the completion of all set exercises in the "Circuit training" program. Once a set is complete, start again with the first exercise for the next set. Traditionally, the time between exercises in circuit training is short. This program was developed by RE Morgan and GT Anderson in 1953 at the University of Leeds in England (Shekhawat and Chauhan, 2021).

Circuit training is used to stimulate increases in muscle size and strength, as well as improvements in local endurance and aerobic system. However, the loads used during circuit training have been kept low to allow a greater amount of work to be done and to develop qualities important to wrestlers such as strength, speed, power and quickness (Hermassi et al. 2019; Zeraatgar et al. 2022). Due to its changing nature and high tempo, the effects of circuit training on the body are different from normal training. Circular training is an exceptional type of training because it prepares the body in a versatile way, regulates body composition and prevents injuries. Maximum performance is achieved in the shortest time by using time efficiently in circuit training. In this context, this training method is widely used due to the effective use of time and light loads (Baechle and Earle, 2000). Body composition parameters are the determining factor in the evaluation of athlete performance. Fat mass in the body has a variable structure, and there is a close relationship between lean mass and height. Fatty masses do not take part in the production of ATP, they prevent movement in the muscles and cause a lot of energy expenditure. For this reason, fatigue occurs quickly and a decrease in the performance of the athlete is observed. In athletes, body lean mass should be high and fat mass should be low (Malina and Geithner, 2011; Özer, 2009; Şenel et al. 2009).

Body composition parameters are of great importance for the evaluation of general health and athlete performance. A large number of measurement and analysis methods have been developed to analyze and examine these values. At the beginning of these techniques and methods is the Bioelectrical Impedance method, which is frequently used (Luque et al. 2014). Determining the muscle cell values of fat, organic substances, bone, intracellular and extracellular fluids that make up the components of the body, observing and evaluating the differences are directly related to general health and the performance of the athlete (Stewart and Sutton, 2012). BIA method; Since it is a safe, inexpensive, fast and effective analysis method, it is widely used by doctors in examining the body composition of patients (Mollaoğlu et al. 2006; Özçetin et al. 2017).

With electrical current, impedance is determined and by formulating the impedance value, body fat percentage (%), body fat value, lean body percentage value, lean body mass, amount of water in the body, body water percentage, extracellular and intracellular fluid values are determined. (Aydın, 2004; Sifîl et al. 2001). BIA analysis method is used safely in determining and examining body composition in children, young people, adults and the elderly, that is, in all age categories. BIA method gives reliable results in all healthy individuals with BMI values in the range of 16-34 kg/m2 without any abnormalities in fluid balance or body (Norman et al. 2012). Validity and reliability studies were carried out in literature studies, and it was reported that accurate results were obtained from BIA analyzes (Brantlov et al. 2017). The aim of this

study is to examine the effect of circuit strength training applied to wrestlers aged 11-13 on body composition and fluid balance in unit training.

MATERIALS AND METHODS

Study Design

20 male wrestling athletes, whose average age is 11.44±1.15 years and average height is 147.45±11.68 cm, who regularly perform their training at Davraz Sports Club and participate in circuit strength training at least once in these trainings, voluntarily participated in our research. Body composition values of the athletes were performed with the Inbody-720 bioelectrical impedance analyzer in accordance with the test protocols. Body weight, total body water, body fat weight, protein, mineral, body fat ratio, BMI, skeletal muscle weight, visceral fat level, waist-hip ratio and in-body score pre-post-test measurements of the athletes participating in our study were performed respectively.

Data Collection

The study was started after the approval of the Süleyman Demirel University Clinical Research Ethics Committee and the permission of the relevant persons and institutions. All participants gave their written informed consent, and our study was carried out following the Helsinki Declaration. The motivation of the subjects was tried to be increased by explaining the purpose and importance of the study. Before starting the test, the subjects were asked to meet their toilet needs, and the subjects did not go to the toilet during the training. The amount of water consumed by the athletes during the training was recorded as liters (lt). Body composition measurements were carried out by recording the personal information of the subjects before the training. Then, the circuit strength training in Table 1. was applied, and the measurements were repeated at the end of the training.

Bioelectrical Impedance Analysis (Inbody-720) measurements: Before starting the measurements, the importance and purpose of the study were explained to the athletes and their motivation levels were increased. Body composition analyzes of the subjects were performed with a bioelectrical impedance (Inbody-720) device with a sensitivity of 0.01 kg. Following the instructions in the user manual, personal information (age, gender, height) was loaded into the device and measurements were started. Subjects were allowed to step into the device by wearing light clothing, removing metal objects, socks and shoes. During the measurements, the athletes were asked to place the heels of their hands and feet on the electrodes. The measurement was carried out by holding the handles connected to the electrode on the device by the athletes during the measurement period. The device calculated information about electrical potential and body weight, body mass index, mineral, total water amount, protein and basal metabolic rate and collected the data of the results in computer environment.

Training Program

Table 1. Circuit training program

20 Min. General Warming Up
• Flat jogging around the mat, warm-up exercises in educational game format - fishing net game • Movements that train the main joints while running at a light tempo. • Injury prevention gymnastic exercises; somersaults and cushion movements • Short sprint output exercises with command
45 Min. Circuit Training
• 10 stations (push-ups, piolet, sit-ups, pull-ups, reverse sit-ups, squat thrusts, jump rope, rope climbing, free squat, medicine ball throwing) • 10 repetitions for each exercise, intensity 50-70%, working time 30 sec., rest 45 sec. • 3 sets, 3-5 minutes rest between sets
Cooldown- Finish
• 10 min (final exercises in educational game format - wheelbarrow game) • 5 minutes stretching cool-down

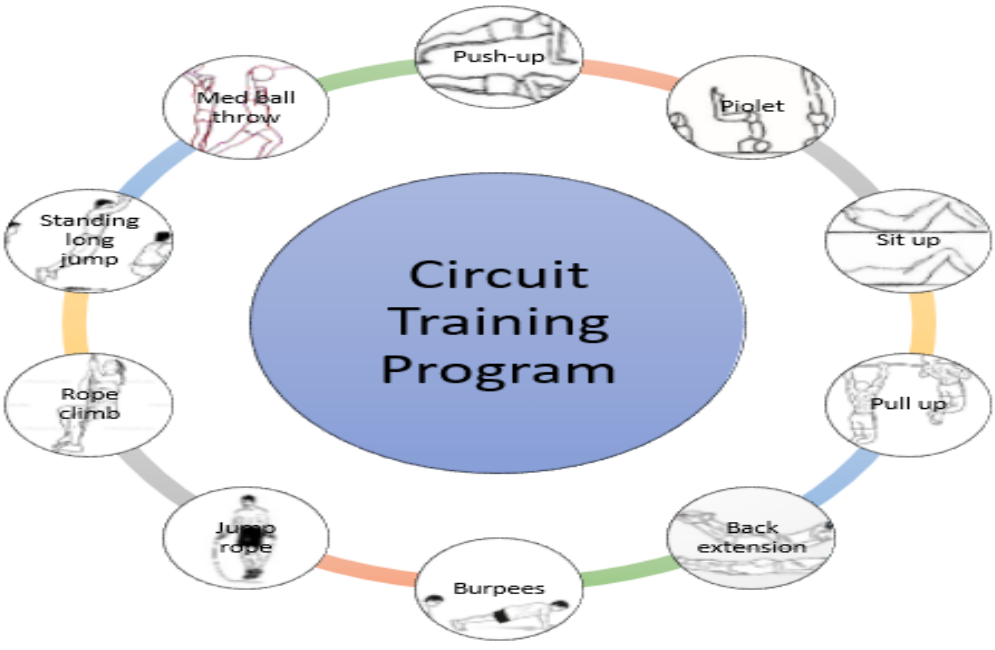

Figure 1. Circuit Training Program Application

Statistical Analysis

Statistics 26.0 and Excel programs were used in the analysis of the obtained data. After performing the Kolmogorov-Smirnov test to determine the distribution of all values, it was determined that the distribution was at a normal level and it was decided to perform analyzes in parametric tests. Paired Sample T-Test was used to analyze the pre-test and post-test data of the subjects. The significance level of the measurements in the interpretation and evaluation of the differences was determined as $p<0.01$ and $p<0.05$.

RESULTS

The findings obtained as a result of the statistical analyzes of the obtained data are as follows.

Table 2: Descriptive Data of Athletes

Group (20 male)	$\overline{X}$	**Ss**
Height (cm)	147.45	11.68
Age (year)	11.44	1.15

Table 3: Examination of Pre- and Post-Test Body Composition Values of Athlete

Test	**Uygulama**	**n**	$\overline{X}$	**Ss**	**t**	**p**
Total Body Water (kğ)	Pre-test	20	24.60	6.96	-.549	0.589
	Post-test	20	24.65	6.96		
Protein (kğ)	Pre-test	20	6.60	1.88	-.400	0.694
	Post-test	20	6.61	1.89		
Mineral (kğ)	Pre-test	20	2.28	0.65	0.584	0.566
	Post-test	20	2.26	0.63		
Body Weight (kğ)	Pre-test	20	41.08	14.33	7.646	0.000**

	Post-test	20	40.68	14.18		
Skeletal Muscle Weight (kğ)	Pre-test	20	17.91	5.69	-.859	0.401
	Post-test	20	17.98	5.70		
Body Fat Weight (kğ)	Pre-test	20	7.60	6.38	0.080	0.937
	Post-test	20	7.59	6.47		
BMI (kğ/m2)	Pre-test	20	18.34	4.01	-2.032	0.056
	Post-test	20	18.39	3.96		
Body Fat Ratio %	Pre-test	20	16.43	9.06	0.184	0.856
	Post-test	20	16.39	9.34		
In Body Score /100	Pre-test	20	77.20	4.70	0.000	1.000
	Post-test	20	77.20	4.91		
Waist Hip Ratio	Pre-test	20	0.77	0.04	-10.466	0.000**
	Post-test	20	0.80	0.04		
Visceral Fat Level	Pre-test	20	2.75	2.71	-1.000	0.330
	Post-test	20	2.85	2.87		

When the data in Table 3. is examined; While no statistical difference could be detected in body fat weight, total body water, body fat ratio, protein, mineral, skeletal muscle weight, visceral fat level, BMI, in body score ($p>0.05$), waist hip ratio and body significant difference was found in weight values ($p<0.01$).

DISCUSSION

Wrestling is an individual sport branch that includes repetitive and explosive maneuvers in which the anaerobic power of the lower and upper extremities, which is a strong determinant of performance success, is transferred to the kinetic chain (Dehnou et al. 2020). In our study, there was no statistical difference in total body water, protein, mineral, skeletal muscle weight, BMI, body fat ratio, body fat weight, in-body score and visceral fat level data ($p>0.05$), but body weight and waist-hip statistically significant difference was found in the rate data ($p<0.01$). It depends on the most efficient development of motoric features, which is the most important element in achieving successful results in sports and in the continuity of performance. The basis of motoric features is innate and increasing the performance of these features occurs with sports (Akçakaya, 2009). Wrestling is a sport branch in which intermittent exercises are performed for muscle strength performance in the upper and lower parts of the body (Bal et al. 2018). In addition to the exercises performed at the maximal or submaximal level, statistically significant differences were determined in the BIA analysis measurements performed before and after the exercise performed in the aerobic system in the literature studies, in body composition values such as body weight, muscle mass, body fat ratio, fluid amount, body fat percentage data. Similarity was detected (Babur et al. 2020; Cutrufello et al. 2016; Romanowski et al. 2015; Yavuz and Dağdelen 2021). Wrestling is a sport branch that is competed in weights depending on the kilogram, and therefore, athletes need to lose or gain significant weight in a short period of time close to the competitions. This situation, therefore, directly affects body composition and causes changes on body parameters (Oppliger and Bartok, 2002). The body composition of the athlete informs the trainers about the physiological structure of the individual, and the body components of an adult consist of 60% water, 15-20% fat, 16% protein, 4-5% minerals (Kehayias et al. 1997).

Studies have shown that the exercises applied in circular training increase the amount of fat burned. In strength training where large muscle groups are exercised, less rest between sets provides aerobic and metabolic benefits. At the same time, when comparing traditional aerobic training with circular training, it was determined that high-intensity circular training was more effective on fat burning. The short listening time between each station also ensures that the total exercise time is short. Circuit training program has been reported to be an ideal training program for

individuals who want to maximize their performance as soon as possible (Klika and Jordan, 2013). Teo et al. (2014) stated that the development of body fat structure in adolescent boys is different than in girls, therefore the level of physical activity is higher than in girls. In addition, the body weight, height, waist circumference and waist-hip ratio of adolescent boys were higher than girls, as expected; They reported that the total body fat percentage in girls was higher than in boys, as we found in our study.

Another study in which the Circuit training program was applied to school-age children found that total body fat and resting systolic blood pressure were significantly lower, while cardiorespiratory fitness significantly improved only in the training group ($P<0.05$), while Body Mass Index and total body fat percentage in the control group significantly increased compared to the period before and after the intervention (Giannaki et al. 2015). It has been reported that circuit training, in which lighter loads are lifted with minimal rest, increases MaxVo2, maximum pulmonary ventilation, conditioning capacity, strength and power, while reducing body fat and improving body composition (Camargo et al. 2008; Gettman et al. 1979; Harber et al. 2004; Monteiro et al. 2008).

In their study on the effects of the circular training program on the muscular and cardiovascular endurance and maintenance of school-age children aged 10-12, it was shown that the circular training program was effective in increasing and maintaining both muscular and cardiovascular endurance among schoolchildren (Mayorga-Vega et al. 2013). Ramos-Campo et al. (2021), as a result of their meta-analysis on 45 studies, determined that resistance-based circular training led to an increase in muscle mass (1.9%) and a decrease in fat mass (4.3%) and it is an effective method for improving the strength of the lower and upper limbs. In a recent study by Yoon and Moon (2018), significant changes occurred in body composition such as body weight, body fat, body fat percentage, BMI, and cardiorespiratory endurance, muscle strength, and muscular endurance through a circular training program. Lee et al. (2009), a circular training program using resistance exercise has been shown to be effective in improving body composition, flexibility, muscle strength, and muscular endurance. As a result, it was determined in the study that circuit strength training applied to wrestlers between the ages of 11-13 had positive effects on some body parameters measured by the Bioelectrical Impedance system and positively affected body composition.

Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Statement

For this study, the permission of the Faculty Ethics Committee was obtained from the Clinical Research Ethics Committee of Süleyman Demirel University Faculty of Medicine. (Approvel Nummer: 72867572-050. 01. 04 – 400922.

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Author Contributions

Study Design, SD; Data Collection, AY; Statistical Analysis, SD; Data Interpretation, AY; Manuscript Preparation, AY, SD; Literature Search, SD, AY. The published version of the manuscript has been read and approved by all authors.

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