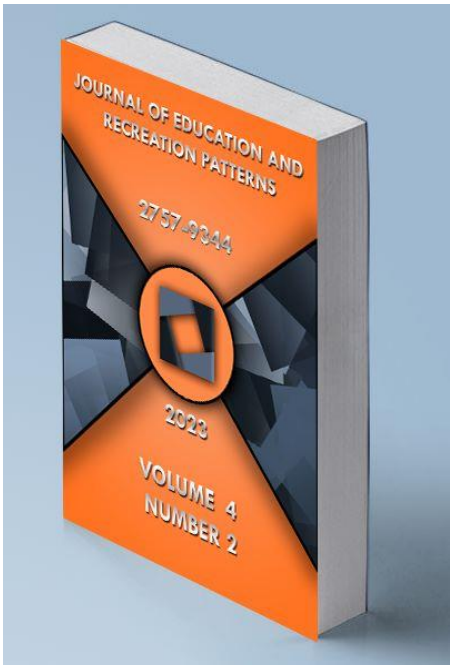

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The Effect of 8 Weeks Preparatory Training Program on Body Composition and Blood Parameters in Elite Wrestlers

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ABSTRACT
The aim of this study is to evaluate the effects of an 8-week training program applied during the preparatory period of elite-level wrestlers on blood parameters and body composition. This study involved the voluntary participation of 10 Greco-Roman wrestlers competing at the national team level and achieving rankings in international tournaments. The participants had an average age of 22.00 ± 3.2 years, an average height of 172.00 ± 8.4 cm, and an average weight of 80.50 ± 11.9 kg. These wrestlers had approximately 12 years of wrestling experience. An 8-week preparatory training program, prepared by experts and coaches, was implemented for participant wrestlers. This training program was applied at the national team level and in the adult category. It was carried out following a 20-day active rest period during the offseason. The following tests and measurements were conducted at the beginning and end of the training program. The data obtained were statistically analyzed using SPSS version 10.0. The mean values and standard deviations of the measured parameters for all participants were calculated. The paired-sample t-test was applied to identify differences between pre and post 8-week preparatory training program. When the participants' blood lipid values were examined, no significant difference was observed in HGB and HCT values between the pre-test and post-test, while RBC and WBC values showed a statistically significant increase ($p<0.05$). When the participants' body composition values were examined, a significant decrease was observed in body fat percentage (BFP) and body fat mass (BFM), while there was a significant increase in lean body mass (LBM) ($p<0.05$). In conclusion, it has been determined that the 8-week preparatory training program has positive effects on weight, body fat percentage, lean body mass, MaxVo2, strength, and immune health.

Keywords: Body Composition, Hematological Parameters, Training Program

INTRODUCTION

Wrestling is one of the oldest combat sports in the world and dates back to as early as 708 BC, being a part of the ancient Greek Olympic Games (Chaabene, et al., 2017; Khalili-Borna & Honsik, 2005; Zaccagni, 2012). Wrestling remains a sport of great significance to people today, much like it was in the past (Petkov & Angelov, 1978). Elite wrestlers typically train for 5 or 6 days a week, often having two or more sessions per day (Demirkan et al., 2015; Horswill, 1992). As competition periods approach, the amount of technical and tactical training increases (Demirkan et al., 2015; Horswill, 1992; Yoon, 2002).

In recent years, changes in the rules of wrestling have led to an increase in the duration, tempo, intensity, and number of matches a wrestler has to participate in. Therefore, training programs and practices have become crucial (Brodthagen et al., 1985; Schwandt et al., 1991). Elite wrestlers' ability to adapt to this intensity depends on undergoing adequate preparation periods. Without sufficient preparation, the short recovery times between training sessions, combined with the physical demands of wrestling, can lead to unwanted fatigue during the weekly cycle and training phase (Chaabene et al., 2017; Yoon, 2002). As a result, it is necessary to conduct a detailed analysis of wrestlers' energy systems, strength, body mass, and blood values, especially in their preparatory training, and adjust training programs accordingly (Akbal, 1998).

In a study conducted on elite wrestlers, the variable maxV02 was found to be significantly different between successful and unsuccessful wrestlers, with first-place wrestlers reported to have lower body fat percentages and higher strength and speed compared to second-place wrestlers (Ziyagil, 1994). These results indicate that subcutaneous fat thickness and weight control are important criteria for success (Yoon, 2002). This is because body fat can have a negative impact on motor skills, and athletes are expected to have low body fat levels (Malina & Geithner, 2011). Wrestlers' off-season body fat values range from 8% to 16%, while during preparatory training, these values range from 3% to 13% (Horswill, 1992; Yoon, 2002).

When we look at changes in blood values, hematological parameters can vary in response to exercise, and these changes can depend on factors such as the type, intensity, and duration of the exercise (Wardyn et al., 2008). During exercise, there is an increase in the concentration of hemoglobin, erythrocytes, and plasma proteins in the blood. This increased concentration assists the body in meeting the elevated oxygen demand during exercise by speeding up blood flow and diverting it from the liquid vessels into the tissues (Karacabey, 2004; Özdengül, 1998). Due to the increased blood flow and rapid circulation during exercise, there is an increased participation of leukocytes (white blood cells) in the bloodstream, leading to an increase in the number of leukocytes in the blood. Hormonal changes induced by exercise can also play a role in this increase (Waern et al., 1993; Akgün, 1994).

Finally, providing a comprehensive examination of the training outcomes regarding body composition and blood parameters during the preparatory period of elite wrestlers will assist coaches and strength and conditioning experts. In conclusion, the aim of this study is to investigate the effects of an 8-week training program applied during the preparatory period of national-level wrestlers on specific hematological parameters and body composition. The goal of this study is to ensure that elite wrestlers undergo a sufficient preparatory period to adapt to the increased intensity in recent times and to analyze their body masses and blood values for the development of training programs accordingly. This study is structured around the following hypotheses:

Hypothesis 1: The preparatory training program for elite wrestlers has an effect on Hemoglobin and Hematocrit parameters.

Hypothesis 2: The preparatory training program in elite wrestlers has an effect on Eritrosit and Lökosit parameters.

Hypothesis 3: The preparatory training program in elite wrestlers has an effect on Body Fat Percentage (%).

Hypothesis 4: The preparatory training program in elite wrestlers has an effect on Body Fat Mass (kg).

Hypothesis 5: The preparatory training program in elite wrestlers has an effect on Lean Body Mass (kg).

These hypotheses form the basis of the research and aim to evaluate the effects of an 8-week training program applied during the preparatory period of elite-level wrestlers on blood parameters and body composition.

METHOD

Research Design

An 8-week preparatory training program, prepared by experts and coaches, was implemented for participant wrestlers. This training program was applied at the national team level and in the adult category. It was carried out following a 20-day active rest period during the offseason. The following tests and measurements were conducted at the beginning and end of the training program. A one-week sample training program is shown in Table 1.

Table 1. Training Program

Week	Day	Training	
		Hour	**content**
An 8-Week Implemented Training Program	Monday	17:30 19:30	Maximal Strength Training, Intensity: 80-100%.
	Tuesday	17:30 19:30	Technical Tactical Practice, Intensity: 60-70%.
	Wednesday	17:30 19:30	Active Recovery
	Thursday	17:30 19:30	Maximal Strength Training, Intensity: 80-90%
	Friday	17:30 19:30	Partnered Strength Training, Intensity: 60-70%.
	Saturday	09:30 11:30	Cross Training and Interval Workouts.
	Sunday		Rest

Research Group

This study involved the voluntary participation of 10 Greco-Roman wrestlers competing at the national team level and achieving rankings in international tournaments. The participants had an average age of 22.00 ± 3.2 years, an average height of 172.00 ± 8.4 cm, and an average weight of 80.50 ± 11.9 kg. These wrestlers had approximately 12 years of wrestling experience. Before measurements were taken, the athletes were informed about the procedures. They willingly agreed to participate in the study, and voluntary participant forms were completed in accordance with the Helsinki Declaration. Prior to measurements, the athletes engaged in a warm-up session that lasted about 10 minutes (consisting of running and stretching). Body composition measurements were taken before the warm-up. The athletes were instructed not to eat, consume caffeine, or take medication for at least 4 hours before the measurements. After being informed about the study and potential risks and discomforts associated with the research and test procedures, written informed consent was obtained according to the Helsinki Declaration (World Medical Association Helsinki Declaration, 2000). All measurements for the research group were conducted by trained professionals in the Laboratory of Hasan Doğan School of Physical Education and Sports at Karabük University and the Public Health Laboratory of the Karabük Provincial Health Directorate.

Table 2. Physical Parameters of Participating Athletes

	Min	**Max**	**Mean ± Sd.**
Age (Years)	19,00	26,00	22,00 ±3,2
Height (Cm)	162,00	184,00	172,00 ±8,4
Weight (Kg)	63,00	106,00	80,50 ±11,9

When Table 2 is examined, the average age of the athletes was found to be 22.00 ± 3.2 (years), the average height was 172.00 ± 8.4 (cm), and the body weight was 80.50 ± 11.9 (kg).

Data Collection Tools

Height and Body Weight Measurement: The participants' body weights were measured on a weighing scale with a sensitivity of 0.01 kg, in kilograms (kg), barefoot and wearing wrestling singlets. Their heights were measured while standing upright with bare feet, using a metal meter with a sensitivity of 0.01 cm fixed on the weighing scale.

Body Composition Analysis: Body fat percentage and body muscle mass measurements of the participants were obtained using the Inbody 120 Bioimpedance Body Composition Analyzer. Body composition analysis involves sending a mild electrical current through electrodes that come in contact with the hands and feet, and the body analysis device is used to measure parameters such as body fat tissue, muscle tissue, body water, and soft tissue.

Determination of Lipid Blood Parameters of Participants: Blood samples of the participating wrestlers were collected into K3-EDTA tubes with purple caps (Becton Dickinson VACUTAINER disodium EDTA) by a phlebotomist on an empty stomach before the start of the training program and after its completion. The collected blood samples were sent to the laboratory within 1 hour for the determination of hemogram values, including WBC, RBC, HGB, and HCT, using the Sysmex XN-1000 (Sysmex Corporation, Kobe, Japan) device. The obtained results were evaluated by a biochemistry specialist.

Statistical Analysis

The data obtained were statistically analyzed using SPSS version 10.0. The mean values and standard deviations of the measured parameters for all participants were calculated. The paired-sample t-test was applied to identify differences between pre and post 8-week preparatory training program (Özdamar, 1997).

FINDINGS

The findings of this study focus on the comparisons between the blood lipid values and body composition of athletes before and after their training periods.

Table 3. Comparative Analysis of Blood Lipid Values Before and After Training in Athletes

		N	Mean ± Sd.	*t*	*p*
Hemoglobin HGB	Before	10	14,49 ±1,9	-1,266	,237
	After	10	14,65 ±2,1		
Hematocrit HCT	Before	10	44,41 ±3,2	,679	,514
	After	10	43,91 ±3,5		
Red blood cells RBC	Before	10	5,12 ±0,6	-2,749	**,023***
	After	10	5,54 ±0,71		
White blood cells WBC	Before	10	6,57 ±2,7	-2,492	**,034***
	After	10	7,27 ±2,9		

When Table 3 is examined, before training: The mean hemoglobin level before training was 14.49 g/dL with a standard deviation of 1.9. After Training: The mean hemoglobin level after training was 14.65 g/dL with a standard deviation of 2.1. Interpretation: There was no statistically significant difference in hemoglobin levels before and after the training program ($p = 0.237$). This suggests that the training program did not have a significant impact on hemoglobin levels in the participating athletes. Before Training: The mean hematocrit level before training was 44.41% with a standard deviation of 3.2. After Training: The mean hematocrit level after training was 43.91% with a standard deviation of 3.5.

Interpretation: Similar to hemoglobin, there was no statistically significant difference in hematocrit levels before and after the training program ($p = 0.514$). This indicates that the training program did not significantly affect hematocrit levels. Before Training: The mean red blood cell count before training was 5.12 million cells/μL with a standard deviation of 0.6.

After Training: The mean red blood cell count after training was 5.54 million cells/μL with a standard deviation of 0.71. Interpretation: There was a statistically significant increase in red blood cell count after the training program ($p = 0.023$*). This suggests that the training program led to an increase in the number of red blood cells in the participating athletes, which can be important for oxygen transport and overall endurance. Before Training: The mean white blood cell count before training was 6.57 thousand cells/μL with a standard deviation of 2.7.

After Training: The mean white blood cell count after training was 7.27 thousand cells/μL with a standard deviation of 2.9. Interpretation: There was a statistically significant

increase in white blood cell count after the training program (p = 0.034*). This indicates that the training program resulted in a higher number of white blood cells, which are important for immune function and response to exercise-related stress.

Table 4. Comparative Analysis of Body Composition Values in Participating Athletes Before and After Training

		N	Mean ± Sd.	*t*	*P*
Body Fat Percentage (%)	Before	10	12,00 ±2,1	3,92	,003*
	After	10	10,87 ±1,8		
Body Fat Mass (kg)	Before	10	11,15 ±2,9	2,39	,040*
	After	10	10,01 ±2,5		
Lean Body Mass (kg)	Before	10	75,56 ±7,7	-10,07	,000*
	After	10	76,55 ±9,1		

When Table 4 is examined, before training: The mean body fat percentage before training was 12.00% with a standard deviation of 2.1. After Training: The mean body fat percentage after training was 10.87%. Interpretation: There was a statistically significant decrease in body fat percentage after the training program (p = 0.003*). This indicates that the training program led to a reduction in body fat percentage among the participating athletes, which is a positive outcome in terms of improving body composition. Before Training: The mean body fat mass before training was 11.15 kg with a standard deviation of 2.9. After Training: The mean body fat mass after training was 10.01 kg. Interpretation: There was a statistically significant decrease in body fat mass after the training program (p = 0.040*). This suggests that the training program resulted in a reduction in the absolute amount of body fat in the participating athletes. Before Training: The mean lean body mass before training was 75.56 kg with a standard deviation of 7.7. After Training: The mean lean body mass after training was 76.55 kg. Interpretation: There was a statistically significant increase in lean body mass after the training program (p < 0.001*). This indicates that the training program led to an increase in lean muscle mass among the participating athletes, which is a positive outcome for strength and athletic performance.

DISCUSSION

The aim of this study is to ensure that elite wrestlers undergo a sufficient preparatory period to adapt to the increased intensity and to analyze their body weights and blood parameters for the development of training programs accordingly. The participants in the research had their parameters evaluated, including Hemoglobin, Hematocrit, Erythrocyte, Leukocyte, Body Fat Percentage (%), Body Fat Mass (kg), and Lean Body Mass (kg), and these results were compared with similar studies.

Numerous studies have been conducted regarding the effects of exercise on hematological parameters (Guyton and Hall, 1996; Çavuşoglu, 1991). Furthermore, it is emphasized that the type and intensity of exercise can impact blood parameters and that exercise itself can influence these parameters (Çavuşoğlu, 1991). In the results of our study, while there were no significant changes in hemoglobin and hematocrit levels, the training program had a notable positive effect on red blood cell (RBC) and white blood cell (WBC)

counts. The increase in RBCs may contribute to improved oxygen transport and endurance, while the increase in WBCs may indicate a positive immune response to exercise. These findings are scientifically important as they provide insights into the physiological responses of elite wrestlers to their preparatory training program.

In a study conducted on elite male Taekwondo athletes during a 4-week training camp, certain hematological blood parameters were examined. According to this study, no significant differences were found in HGB, WBC, and HCT values, while a statistically significant increase was observed in RBC values (Spodaryk, 1993). While HGB, HCT, and RBC values were similar to our study, WBC values showed differences, which were thought to be due to the shorter duration of the training. In a study on Olympic athletes, it was found that sports emphasizing endurance had higher RBC levels, and athletes had higher RBC levels compared to sedentary individuals. The results of this study support our findings. Telford and Cunningham (1991) reported a significant increase in WBC levels in 12 male athletes after a 6-week intense training program. This aligns with our study. In another study, Patlar (2010) found that especially resistance exercises led to an increase in stress and cortisol levels, which in turn resulted in an increase in leukocyte levels. Additionally, Patlar (2010) reported a significant increase in HCT values in 10 athletes after a 20-day chronic exercise program. Other studies, such as Günay et al. (2006), Nieman et al. (1999), Freund et al. (1991), Ersöz et al. (1995), and Wade et al. (1987), have also reported changes in hemoglobin levels due to exercise. Nieman and colleagues observed an increase in hemoglobin levels in sedentary individuals after exercise (Nieman et al., 1999). Also, Bayer, Eken, Yağın ve Ilkim (2022) found that the act of fasting during Ramadan can have detrimental effects on anaerobic performance, particularly when individuals experience high levels of hunger. The difference in these studies could be attributed to the significantly lower number of training days.

Achieving optimal body composition is a significant concern for wrestlers, and body fat percentage is believed to be of particular importance to athletes and coaches. Furthermore, it has been noted that "wrestlers are among the athletes with the lowest body fat percentages in categorized weight sports activities" because having a low body fat percentage is believed to be advantageous for optimal performance (McArdle et al., 1998). In our study, we observed a statistically significant decrease in body fat percentage and body fat mass after the training program. This indicates that the training program led to a reduction in body fat percentage and the amount of body fat among the participating athletes, which is a positive outcome for improving their composition.

In one study, they observed a decrease in fat mass and an increase in lean body mass with only regular exercise, without implementing any specific diet (Karakaş et al., 2005). In another study, the impact of strength training on body composition was examined, and significant reductions in body fat percentage and body fat mass, as well as a significant increase in lean body mass, were observed before and after the training period (Harbili et al., 2005). In a similar study, the effects of continuous interval running training on body composition were investigated, and they found a significant decrease in body fat percentage. These findings support the results of our study (Revan et al., 2008).

As mentioned by Peterson et al. (2006), muscle strength allows a specific muscle to produce the same amount of work in a shorter amount of time, which is crucial for activities like sprinting, jumping, and rapid changes in direction (Civan et al., 2022). These characteristics are also relevant to wrestlers, as both offensive and defensive maneuvers in wrestling require high-level and maximum strength (Mirzaei et al., 2011; Mirzaei et al., 2009; Passelergue & Lac, 2012; Yoon, 2012). In this study, there was a statistically significant increase in lean body mass after the training program. This indicates that the training program led to an increase in lean muscle mass among the participating athletes, which is a positive outcome for strength and athletic performance. Many studies have reported that high muscular

endurance is one of the key fitness factors contributing to wrestling performance success (Horswill, 1992). It has been stated that training experience significantly influences performance achievements in strength-endurance tests in wrestlers, with longer training experience (over 9 years) leading to higher values compared to those with average (7-9 years) or shorter training experience (up to 6 years) (Sterkowicz & Starosta, 2005). This finding emphasizes the importance of a wrestler's training history on their level of muscular endurance (Chaabene et al., 2017). Our findings are consistent with the results in the literature.

Conclusion

In conclusion, it has been determined that the 8-week preparatory training program has positive effects on weight, body fat percentage, lean body mass, MaxVo2, strength, and immune health.

In light of all this information and based on our study and literature review, it is clear that our findings indicate positive improvements in the performance of elite wrestlers who participated in the designated training program and were exposed to high-intensity exercise. Furthermore, the 8-week wrestling training not only did not cause an increase in red blood cell and white blood cell counts, but it also had a positive impact on body composition, leading to a decrease in body fat percentage and body fat mass, while increasing lean body mass (muscle mass). These findings suggest that the training program positively influenced oxygen transport, high muscular endurance, which is considered one of the key fitness factors contributing to wrestling performance, and, in light of the literature, may have a positive effect on immune health. Therefore, it is recommended that all wrestlers regularly participate in preparatory training programs. Future research may explore whether there are effects beyond physical fitness, such as autophagy (cell renewal), in wrestlers.

Limitations

In this study, 10 elite-level wrestlers with an average age of 22 years who trained wrestling for 8 weeks and 5 days a week and who obtained degrees in international tournaments participated.

One limitation of this study is the sample size. The study may have been strengthened with a larger and more diverse group of elite wrestlers. A larger sample could provide a broader perspective on the effects of the training program. The study's 8-week preparatory training program may not capture the long-term effects of such training. Longer-term follow-up assessments could offer insights into the sustainability of the observed changes in body composition and blood parameters.

Future research could benefit from monitoring and controlling athletes' diets during the training period to isolate the effects of exercise. The absence of a control group in this study makes it challenging to attribute changes solely to the training program. Including a control group that does not undergo the training could help establish causation.

Recommendations

Conduct long-term studies to assess the sustainability of the observed improvements in body composition and blood parameters. This would provide a more comprehensive understanding of the training program's impact on elite wrestlers' health and performance.

Incorporate dietary analysis and control into future research to differentiate the effects of exercise from diet. This would offer a more comprehensive view of the factors influencing body composition.

Include a control group in future studies to better establish the causal relationship between the training program and the observed changes. A control group would help account for external factors that might influence the results.

Expand the participant demographics to include a more diverse group of elite wrestlers. This would enhance the generalizability of the findings to a broader population of athletes.

Explore additional health assessments beyond physical fitness, such as autophagy or immune function, to gain a more comprehensive understanding of the holistic impact of training programs on wrestlers' health.

In summary, while this study provides valuable insights into the positive effects of an 8-week preparatory training program on elite wrestlers, it is important to acknowledge its limitations. Future research can build upon these findings by addressing these limitations and conducting more extensive and comprehensive investigations into the impact of training on athletes' health and performance.

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