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Comparison of anthropometric indicators, heart rate, lactate and lactate dehydrogenase of champion wrestlers of the province in three different age groups

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Abstract

Background: Since the physiological and physical factors of the body may change due to wrestling, in this study, the effect of strenuous exercise was investigated in different age groups of wrestlers.

Methods: This semi-experimental study was conducted on 21 wrestling champions of Golestan province in three age groups, including teenagers, young adults, and adults (7 people in each age group), using the availability sampling method. They performed strenuous exercise on a treadmill at a speed of 6 km per hour until exhaustion, and their biochemical and physical factors were measured before and after running.

Results: According to the results obtained from the research, although the heart rate of adult wrestlers was lower than that of teenagers and young adults before and after the activity and the concentration of LDH and La was higher, based on the findings, intra-group and inter-group changes in anthropometric variables and HR (Heart rate), La (Blood lactate) and LDH (Lactate dehydrogenase) were not statistically significant in all three groups ($p \leq 0.05$).

Conclusion: The heart rate decreased with the increase in the age group, which may be due to long-term training adaptation. Also, the LDH concentration increased with the age group of the wrestlers, which may be due to the high number of fast-twitch fibers and the muscularity of this age group, although there was no significant difference between the indicators of the present research among the three groups.

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Introduction

When you exercise, your body uses oxygen to break down glucose for energy. During intense exercise, there may not be enough oxygen to complete this process, so a substance called lactate is created. Your body can convert this into energy without using oxygen (1). Lactate dehydrogenase is an enzyme that converts lactate to pyruvate (2). Physical activity has different effects in terms of the size of the effect on different organs of the body (3). Sports activities, especially in heavy disciplines such as wrestling, rely on phosphagen and lactic acid systems (4). In sports such as kickboxing, which includes alternating stages of stopping and movement, muscle glycogen reserves are reduced, and this reduction leads to earlier fatigue in athletes whose glycogen reserves are lower than usual before starting the activity (5). Therefore, one of the basic challenges that athletes tend to overcome or delay to improve their performance is the fatigue process (6). Various factors play a role in the appearance of fatigue, which differ based on the type of sports activity and its intensity (7).

From the point of view of the body's metabolic system, wrestling is considered one of the heaviest sports and needs a suitable training design to increase physical fitness in order to resist severe changes in the blood plasma acid-base system. A wrestler's body needs strength, power, and muscular endurance. In intense exercise such as wrestling, the concentration of intracellular lactate increases to 30 mmol/L or more, which is associated with a decrease in intracellular pH. It is worth considering that the duration of a wrestling match may last from 10 seconds to 6 minutes, so strengthening all three energy systems should be on the agenda of coaches. In addition, the increase in anaerobic metabolism through glycolysis increases the production of lactate and acidity in active muscles and the accumulation of hydrogen ions. This problem, in turn, can cause a decrease in performance in intense sports activities (8). The normal amount of lactate is 0.5 to 2.2 mmol per liter (9), which increases to 20 to 25 mmol per liter in complete fatigue (10). Blood flow disperses lactate throughout the body. During intense sports activities such as combat sports that are based on strength, speed, agility, and endurance, oxygen consumption increases 20 times compared to rest and its consumption in the muscle fibers involved in sports activity increases to 200 times and can increase the production of radicals, release and create oxidative stress in the body (11). The phenomenon of oxidative stress is caused by intense physical activities and a lack of oxygen on the cell surface and causes damage to the cell and membrane. These include lactate dehydrogenase and creatine kinase (12).

Therefore, considering this problem in wrestling, there is a need to design a special training program so that the sports performance of the athletes does not change. Based on this problem, in this research, the acute training program is examined on the above indicators in different age groups.

On the other hand, as mentioned, the decrease in blood pH caused by metabolic acidosis causes a decrease in body muscle strength through several mechanisms. Acidosis, by reducing the activity of enzymes affecting the energy production cycle and also by disrupting the contraction of muscle fibers, causes a decrease in the strength of muscle contraction and ultimately a decrease in the strength, power, and endurance of the body's muscles. It is in such conditions that the role of strength training and scientific bodybuilding of wrestlers shows its importance. Therefore, designing and performing exercises with a high lactic acid threshold is a suggested method that needs to be investigated.

Most researches have shown that energy systems are fundamental factors in the development of sports skills, and the importance of these factors in wrestlers, due to their working conditions, is not hidden from anyone. But what needs to be known and understood more is how these capabilities and factors are related to the physiological and structural characteristics and the role that each of them has (13). In this context,

one of the sports fields where the success of the athletes depends on the physical and physiological characteristics of the champions indicates that the design and planning of appropriate exercises has a lot to do with the conditions and nature of the sports field and the athlete's abilities, and the training program of the athletes should be based on the knowledge of the physical characteristics and the physiological body and should be adjusted according to the sports field (14).

According to Eckerson's findings, young elite wrestlers have a relatively high percentage of lean body mass, strength, and muscle power, and are somewhat equal to competitive elites and adults. In general, today, many studies have been conducted in the field of physical structure and physical factors in various sports fields, but it seems that the study in the field of examining the physical and structural characteristics of athletes in individual fields, especially wrestling, is rare in our country, or in some fields, it does not exist at all. This issue prevents the identification of the strengths and weaknesses of elite athletes and makes it difficult to access and be aware of the current situation of champion athletes (15).

As a weight-dependent sport, wrestling needs to increase muscle strength without increasing muscle mass, so that the athlete can compete with maximum physical strength in the lighter weight group. In teenage and young wrestlers, it is very important that, in order to prevent physical injuries and growth disorders, by finding a suitable weight group, one should refrain from losing weight and going to a lighter weight group. New research has shown that adolescents and young people who are exposed to severe changes of weight loss, in addition to physical growth disorders, are very prone to physical injuries. Therefore, it is important to study the anthropometric structure of wrestlers in different categories.

In the end, considering the importance of the subject and the inadequacy of internal research in this research field to know the anthropometric characteristics of wrestling champions of the province in different age categories, the correct guidance of wrestling champions in younger age categories based on the characteristics of the champions in higher age categories and advice to wrestling champions and coaches to strengthen energy-producing systems in wrestlers, investigation and comparison of anthropometric characteristics of wrestling champions in different age categories of Golestan province has been designed and implemented.

Methods

This study is a semi-experimental method on the wrestling champions of the province (At least one provincial championship) in the age groups of teenagers (16-14 years) with a body mass index of 24.48 ± 5.53, youths (17-18 years) with a body mass index of 24.81 ± 5.26, and adults (24-19 years old) with a body mass index of 24.97 ± 1.99, who were 7 people in each age group, and was conducted using the available sampling method. All people voluntarily participated in the research based on the conditions of the research and signed the consent form.

In the first stage, people got acquainted with the purpose and nature of the research and how to cooperate with the researcher. Then the blood pressure of the people was measured by a specialist doctor; the height of the subjects was measured using a caliper (Iranian scale model with a caliper system) with a sensitivity of 5 mm, weight with a sensitivity of 100 grams, and body fat percentage was measured using a bioelectrical impedance device (Bady analyzer medicit made in Sweden). By dividing the body weight by the square of the height in meters, the body mass index was obtained in kilograms per square meter. To measure resting blood lactate, the wrestlers were told to gather at the championship stadium after waking up without training, then a senior expert took a test of the wrist vein of the wrestlers while lying down, and then put it into the plastic test tubes containing EDTA anticoagulant liquid from Vathiq sample, to analyze blood lactate by ELISA method. All the measurements were done while the subjects had refrained from eating and drinking for eight hours (16) before the test and their bladder, stomach, and intestines had been emptied. Blood sampling was done immediately before and immediately after the exercise protocol.

In the current study, the research articles used followed ethical considerations, and an effort was made to create the necessary transparency for the audience in the transfer of the findings and results of previous studies and to avoid any bias in reporting the results. Honesty and trustworthiness have also been observed in the analysis of texts and citations. This article was registered with the Research Vice-Chancellor of Golestan University of Medical Sciences with the ethical code 340791022020.

The method of implementing the exercise protocol: First, the subjects warmed up on a treadmill with a speed of 5 km and a zero-degree incline for 3 minutes, then we increased the speed by one degree incline and one kilometer every minute, that is, the first phase of the incline is one degree with a speed of 6 km, then in the next phases, we overloaded the same process by increasing the slope by one degree and increasing the speed by one kilometer until the athlete reached the point of exhaustion, and at the end of each phase of the exercise, we recorded the athlete's heart rate by chest polar.

The collected data were analyzed with the help of SPSS version 15 software. After confirming the normality of the theoretical distribution of the data by using Shapiro-Wilk's exploratory statistical test and the homogeneity of variances by Levene's test, to compare the intra-group and inter-group averages, respectively, the paired t-test in dependent groups and the one-way analysis of variance statistical test in independent groups were used and, to determine the significance of the results, the level of $P < 0.05$ was considered as the decision rule.

Results

The anthropometric characteristics, heart rate, and biochemical factors of the subjects as well as the statistical analysis of the variables of all three groups are shown in Table 1 and Figures 1- 3. According to the results obtained from the research, although the heart rate of adult wrestlers, compared to teenagers and young adults, was lower and the LDH and La concentrations before and after the activity were decreased, based on the findings, intra-group and inter-group changes in anthropometric variables, HR (Heart rate), La (Blood lactate) and LDH (Lactate dehydrogenase) were not statistically significant in all three groups (Equal to 0.527, 0.840, 0.976, 0.394, 0.81, 0.777, 728 respectively).

Table 1. Heart rate, lactate dehydrogenase, blood lactate and Anthropometric characteristics before and after exercise in three different age groups (Mean±SD)

Variable / Groups (yr)	Average heart rate (Min)		Lactate dehydrogenase (mg/dL)		Blood lactate (mmol)		Height (cm)	Weight (kg)	Body mass index (kg/ m2)	Body fat (%)
	Pre	Post	Pre	Post	Pre	Post				
Adolescents 14-16	73 ± 6	181 ± 5	437/67 ± 99/53	540/11 ± 88/06	47/83 ± 6/81	120/78 ± 8/65	172/44 ± 7/71	73/22 ± 19/09	24/48 ± 5/53	13/67 ± 9/58
	P-value: 0.738		P-value: 0.891		P-value: 0.683					
Youth 17-18	71 ± 7	180± 4	432 ± 112/79	517/71 ± 144/31	49/28 ± 4/25	113/71 ± 16/74	176/13 ± 5/11	77/50 ± 17/32	24/81 ± 5/26	14/20 ± 6/21
	P-value: 0.928		P-value: 0.763		P-value: 0.613					
Adults 19-25	65 ± 6	179 ± 2	404/67 ± 51/51	477/88 ± 73/75	51/20 ± 12/37	128/16 ± 12/13	175/13 ± 7/37	76/63 ± 8/33	24/97 ± 1/99	18/87 ± 8/64
	P-value: 0.551		P-value: 0.628		P-value: 0.805					
P-value between 3 groups	0.571		0.703		0.681		0.903	0.621	0.831	0.509

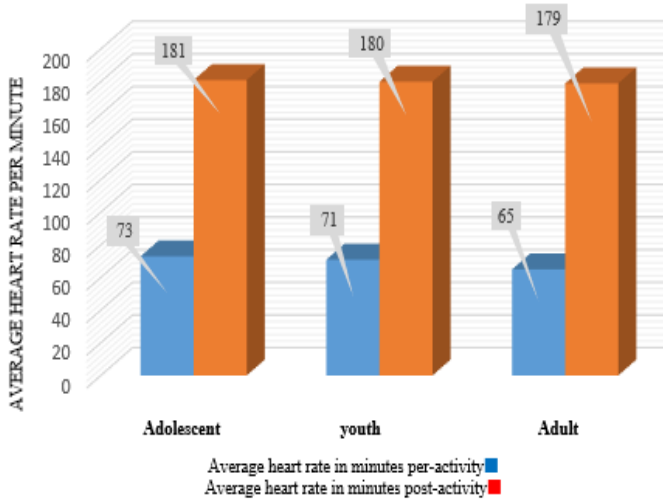

Figure 1. The average heart rate of subjects in three groups before and after the activity

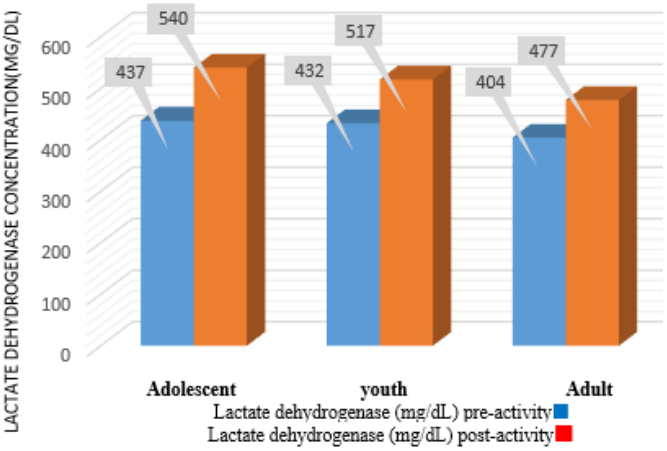

Figure 2. Average lactate dehydrogenase enzyme of the subjects before and after the activity

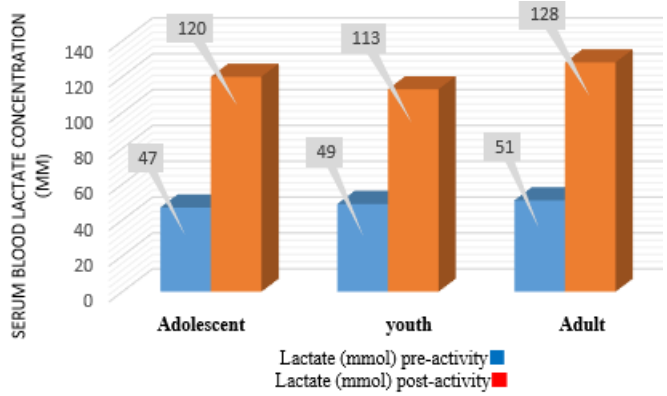

Figure 3. The average blood lactate concentration of the subjects before and after the activity

Discussion

The purpose of this research is to determine whether a round of training up to the stagnation stage has an effect on some anthropometric and biochemical indicators of wrestling champions in the age groups of teenagers, youth, and adults.

Based on the results of this research, there was no significant difference between the anthropometric indices before and after the presentation of the exercise protocol in the three groups. Considering the closeness of the body mass index of the three age groups to each other (Table 1), it can be said that due to the passage of physical puberty, there is no difference in weight and height in the three age groups, but the percentage of body fat increases with the age group, although this change was not significant. This change in body composition may be attributed to the amount of physical activity, the amount and type of food consumed, and physiological hormonal changes in adulthood.

Based on Table 1, which compares the physiological characteristics of wrestlers in three age groups, it can be seen that the heart rate of adult wrestlers before exercise is 65 ± 6 and after the activity is less than that of teenagers 73 ± 6 and youths 71 ± 7. Although there is no significant difference between these changes, this lower heart rate in adults is probably related to the adaptation of the cardiovascular system to the long-term training of adult wrestlers, and the more years of training, the more cardiovascular structural changes. In this regard, the findings of Cohen and Segal show that left ventricular wall and septal mass were greater in wrestlers compared to non-athletes or endurance athletes.

As a result, with the increase in the mass of the wall, the strength of the heart increases and the heart pumps out more blood volume with each beat. Physiologically, this adaptation is necessary for the continuation of blood flow in the muscle despite the increase in vascular resistance due to isometric contractions in the muscles during wrestling (17).

A study on adult wrestlers from Serbia reported that the cardiac and metabolic responses of national, first, and second-league wrestlers did not differ according to the specific wrestling fitness test (18). Moreover, a study on Croatian wrestlers revealed no significant differences in the La concentrations accumulated during a wrestling match between the national team and club-level wrestlers (19). This could be explained by the fact that the specific wrestling fitness test and the biggest part of the wrestling match are predominantly anaerobic-glycolytic activities, which lead to high production and accumulation of blood La, placing high demands on aerobic metabolism (Cardiovascular functions) to remove La from the blood during recovery (18,19). Therefore, wrestling-specific performance corresponds to match requirements and leads to adaptations in cardiac and metabolic outputs (20).

According to the present results, the amount of blood lactate and lactate dehydrogenase enzyme of adult wrestlers is higher than that of teenagers and young people before and after the activity, although this difference is not statistically significant. These findings mean that the wrestlers participating in the current research are the same in terms of lactic acid tolerance and increased lactic acid accumulation in the blood until the stage of reaching exhaustion on the treadmill. Perhaps this equality can be attributed to the type of activity performed (running on the treadmill until reaching the stage of stagnation). Because, based on the principle of exercise, running on a treadmill probably did not create the necessary intensity to reach the lactate peak. Huston and his colleagues reported a 10-fold increase in blood lactate levels (10.5 ± 1.4 mmol/L and pH = 7.06) in elite wrestlers after 4 minutes of wrestling competition (21). In real competition conditions, after 6 minutes of wrestling (2 times of 3 minutes with 1 minute rest between them) average blood lactate levels were reported to be 10.5 to 11.6 mmol/L.

Therefore, more detailed studies in humans have shown that only very muscular exercises, severe or moderate in untrained people, cause an increase in serum enzymes so that serum enzymes reach the level of pathological cases. To determine the effect of the duration and intensity of muscle training on serum enzyme changes and muscle damage, Tedios and Lanozzo investigated the introverted and extroverted contractions of the leg extensor muscles. The results obtained during 8 to 48 hours after the activity from the blood data indicate the greatest increase in the activity of serum enzymes and muscle disorders. Among the visible symptoms due to hard and intense training, we can mention the increase of serum enzymes, increase of DNA enzyme, stimulation of oxidative stress, and increase of signs of cell damage. Especially, outdoor exercises lead to specific symptoms such as severe inflammation and edema (22).

The anaerobic-glycolytic activity leads to high production of blood La, which is why the power of aerobic metabolism (i.e., cardiovascular function) is of high importance for wrestlers during recovery in order to accelerate the removal of La from the blood. Therefore, the training specificity corresponds to the requirements of the match, which leads to specific adaptations that occur at the level of muscle fibers, cardiac output, and metabolic profile (23). Considering this, it could be stated that wrestlers of higher proficiency have advanced adaptation of the

cardio-metabolic system to perform better and recover faster than wrestlers of lower proficiency. Moreover, these differences may reflect disparities in player conditioning and skill level between competitive levels.

Therefore, the possible effective mechanisms in this process may be related to the increase in growth hormone secretion and also the increase in anabolic activity from the activity of alpha-octodehydrogenase enzyme, which increases the oxidation of branched-chain amino acids.

Finally, it should be noted that in the current study, the amount of lactate changes was not monitored in several time periods after the end of the activity, which is recommended to be used in future studies. It is suggested to follow the changes of lactate with a longer time span in other researches in order to get a better understanding of the amount of lactate changes after exercise at different ages.

Conclusion

The results of this study suggest that wrestlers of higher proficiency level perform better, for which they have the support from cardiac and metabolic profile obtained by specific training. In that regard, coaches should be choosing exercises, intensities, loads, and training tools that support specific adaptation of biological systems that are responsible for the efficacy of performance and/or recovery of wrestlers. These findings have implications for the evaluation and training of wrestlers, highlighting the importance of incorporating sport-specific tests after exhaustive exercise, match, or testing protocols to accurately assess their performance and tailor training programs accordingly. Therefore, future research on sport-specific performance in wrestlers in all age groups and weight categories should be conducted after exhaustive exercise or testing protocols.

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Ethical statement

In the current study, the research articles used followed ethical considerations, and an effort was made to create the necessary transparency for the audience in the transfer of the findings and results of previous studies and to avoid any bias in reporting the results. Honesty and trustworthiness have also been observed in the analysis of texts and citations. This article was registered with the Research Vice-Chancellor of Golestan University of Medical Sciences with the ethical code 340791022020.

Conflicts of interest

The authors hereby declare that there was no conflict of interest.

Author contributions

Conceptualization: Abolfazl Aghababaeyan. Data curation: Abolfazl Aghababaeyan, Sadegh Ali Azimi, Mohammad Bagher Nikzad. Formal analysis: Mohammad Bagher Nikzad. Funding acquisition: Abolfazl Aghababaeyan, Sadegh Ali Azimi, Mohammad Bagher Nikzad. Investigation: Abolfazl Aghababaeyan. Methodology: Abolfazl Aghababaeyan. Project administration: Abolfazl Aghababaeyan. Resources: Abolfazl Aghababaeyan. Software: Mohammadbagher Nikzad. Supervision: Sadegh Ali Azimi. Validation: Abolfazl Aghababaeyan, Sadegh Ali Azimi, Mohammad Bagher Nikzad. Visualization: Abolfazl Aghababaeyan, Mohammad Bagher Nikzad. Writing-original draft: Abolfazl Aghababaeyan, Sadegh Ali Azimi, Mohammad Bagher Nikzad. Writing-review editing: Abolfazl Aghababaeyan, Sadegh Ali Azimi, Mohammad Bagher Nikzad.

Data availability statement

The data are not publicly available due to ethical considerations and privacy concerns, but an anonymized version of the data can be obtained by contacting the corresponding author.

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