https://doi.org/10.33472/AFJBS.6.6.2024.8926-8934

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Effect of Woman Boxers in the Competition Period of Training on Lactate, Heart Rate And Fatigue Index

Doğukan Hakan Atçeken[1], Oktay Çakmakçi[2]

[1,2]Selcuk University, Faculty of Sport Science, Konya, Turkey.
Orcid: [1]0000-0002-9750-615X
Orcid: [2]0000-0002-8612-1334, mail: ocakmakci2000@gmail.com.
Address Correspondence to DH. Atçeken: email: dogukanhakan@hotmail.com

Article Info

Volume 6, Issue 6, September 2024

Received: 01 August 2024

Accepted: 24 August 2024

Published: 05 September 2024

doi: 10.33472/AFJBS.6.6.2024.8926-8934

ABSTRACT

Study was conducted in order to examine effect of 6-week competition period boxing trainings on peak anaerobic strength, fatigue and recovery levels.

6 female boxers whose age average was 21,16±0,75 and who were students of Faculty of Sport Sciences in Selçuk University, participated in the study as volunteer subjects. Before and after 6 weeks of training, subjects' peak anaerobic strength, peak relative anaerobic strengthand fatigue indexes were measured by using Monark 824 model (made in Sweden) wingate arm ergometer. Before and after arm wingate anaerobic strength test, fatigue and recovery levels of subjects were measured by using lactate scout (Lot:0443401, Made in Germany) device and Polar RS800 (Made in Finland) device in 10 different time periods (resting, fatigue, after 1 min, after 3 min, after 6 min, after 9 min, after 15 min, after 30 min, after 60 min, after 90 min). While making statistical analyzes of data, paired-t test was used in order to determine the difference between pretest and posttest values.

In the parameters measured; fatigue index and peak anaerobic power levels between pretest and posttest are similar, there are significant increase in peak relative anaerobic strength level ($p<0,05$). There is no difference between pretest and posttest lactate timings. HR (heart rate) posttest resting value is significantly lower than pretest resting value ($p<0,05$), other timings are similar. Consequently; it can be said that 6-week competition period boxing training improves lactate tolerance and threshold in female boxers and there is an increase in peak anaerobic strength, in addition, it contributes to fatigue and recovery levels.

Keywords: Female Boxer, Arm Anaerobic Strength, Fatigue, recovery.

1. Introduction

Boxing is one of the branches that require body contact and body struggle with the way it is done. This sport is a branch of sports that is based on two athletes wearing gloves specific to the branch and fighting according to the rules of the branch (Savaş and Uğraş, 2004). It is seen that it provides improvement in anaerobic power, muscle strength endurance, flexibility, hand and eye coordination, foot games, quickness and reflexes that occur after boxing training (Quinn, 1994). Boxing sport needs adaptation to strength, dynamic and static features (Soslu et al., 2018). Boxing sport has a complex structure consisting of high performance, dynamic and static features, and is included in the fighting branches that require strength and effort (Mitchell, Haskell, and Raven, 1994).

The performance of a heavyweight athlete such as a boxer is a combination of many different components. Athletic achievement relies on both advanced technical skills and the degree of fitness component development (Tatlici et al., 2021). Although boxing is primarily a talent job, combining this talent with skill, intelligence and strength is the primary factor for success in boxing. In addition to these, physical fitness values such as endurance, continuity in strength, anaerobic and aerobic power, strength and flexibility can be listed (Zorba et al., 1999). Muscle strength can be defined as the ability to produce a high amount of force in the shortest time. The punching action required for boxing should be done in the fastest and strongest way, in other words, it should be done in a powerful way. Since punching is a very fast and short movement, the energy system used is the high-energy phosphate system (Piorkowski et al., 2011)

Boxing demands a high-developed technical, tactical ability and a high physical and physiological fitness level to succeed. The high-intensity performance in the period of rounds, with insufficient breaks for maintaining, is identified with amateur boxing (Chaabène et al., 2015). Explosive loading, as a category of loading, has a brief duration of under 6 seconds and primarily depends on the high-energy phosphagen system within the primary energy metabolic pathway, with supplementary participation from glycolysis and oxidative phosphorylation (Taşkuyu 2020; Taskuyu and Yılmaz 2021). It is reported that the higher anaerobic threshold you have, the more you can succeed in boxing (Tatlici and Cakmakci, 2019). it has been observed that amateur boxing (a form of 3X3) demands durability in the period of a boxing match (Çakmakçı et al., 2019). Boxers should have well-developed muscle strength and power to sufficiently manage the physical and technical-tactical needs (Kravitz et al., 2003; Pierce Jr et al., 2006).

Most combat sports require a mix of technical, strength (Tatlıcı and Löklüoğlu, 2022), aerobic fitness, power and speed. Often a single performance feature is not dominant in martial sports. The physiological responses, especially the heart rate and the maximum oxygen uptake (VO2max), the blood lactate values vary even according to the weight category and the rounds (Slimani et al., 2017). There are limited studies about woman boxers. Therefore, the aim of this studie was examine effect of 6-week competition period boxing trainings on peak anaerobic strength, fatigue and recovery levels in woman boxers.

2. Methodology

2.1 Subjects

A total of 6 female boxers studying in Selçuk university at Sports Science Faculty were recruited to participate voluntarily in the study. All subjects were first informed about the aim and possible risks of the study. All subjects provided written informed consent. The study protocol was approved by the Ethics Committee of the Selçuk University Sports Science Faculty, Konya, Turkey (date 28.01.2021/ code 12).

Data of 6 boxers (age: 21.16 ± 0.75 years, height: 173,50±3,27 cm, weight: 65,28±8,95 kg, still active) were used in the analyses. Subjects were required to fulfill the following inclusion criteria: subjects were needed to fit in the following inclusion criteria: (1) an absence of disease or of an orthopedic disorder that obstructs 30-s anaerobic Wingate test (2) no medication (3) no nutritional supplements; (4) no smoking in the six months prior to the study beginning.

2.2 Procedure

The subjects were applied for 6 weeks of boxing training. While in the first 4 weeks, female boxers were applied 6 days training in a week, 5 days training in a day was applied in the last 2 weeks. Each boxing training which made for the competition was done at 18:00 pm.

Subjects were subjected to height, weight and anaerobic arm Wingate test before 6 weeks of training. Before and after anaerobic arm Wingate test, 10 measurements were taken during the 90-minute period for heart rate and blood lactate levels. Fatigue index (YI%), peak anaerobic power and relative peak anaerobic power levels were determined after arm Wingate test. All procedures were applied again after 6 weeks of boxing training but within the same frame.

2.2.1 Wingate Arm Anaerobic Power and Capacity Test

Before the Wingate test, participants' resting heart rate was measured with a polar (RS 800 made in Finland) device. Shortly after, their resting lactate samples were taken from the fingertip of the hand by using lactate scout analyzer (Made in Germany) with lactate scout test strips (Lot:0443401, Made in Germany). All blood samples were taken from the middle fingertip.

Subjects performed the Wingate anaerobic test following standard procedures. Monark cycle ergometer (Monark 824, Sweden) was used to determine the anaerobic power parameters of subjects. The cycle ergometer height was adjusted to the height of participants' arms and noted them for the second test. The 30-second protocol was performed on a cycle following a 5-minute warm-up at a rate of 60–70 rpm. The warm-up included 3 separated maximum sprint against %20 resistance load, from the calculated load, for 4-8 seconds. Each participant was allowed to maximize pedal tempo about 2-3 seconds prior to test onset. When the time of Wingate test beginning, a prearranged load equivalent to 0.050kg·kg1 24 body mass was applied to the flywheel and pedal precession counting begins for the 30 seconds. Participants were motivated by two instructors to pedaling as fast and as powerfully as possible while remaining standing through the time left. After 30 second loadings, participants cycled with free resistance for a cool down (not more than 1 min). Peak power, relative peak power, and fatigue index were recorded (Özkan et al., 2010).

2.2.2 Training P Training Program

Competition Period Training Program (6 weeks)		
20% Special Condition	**40% Technical Training**	**40% Tactics and Matches (Sparing)**

Sparing; The most similar boxing training to the competition
Special Condition; Bag, sparing, weight and running exercises
Technical Training; Paired gloves training program.

2.2.3 Lactate Measurement

The blood lactate values of the athletes were measured with a fingertip lactatescout device. In the resting state, immediately after the exercise test (fatigue), a total of 10 measurements were taken from the fingertips of the athletes after 1st, 3rd, 6th, 9th, 15th, 30th, 60th, 90th minutes. The blood was analyzed with a lactatescout device within 10 seconds. The obtained values were recorded in mmol/L-1. It was measured with lactate scout test strips (Lot:0443401, Made in Germany) using a lactate scout device (Made in Germany).

2.2.4 Heart Rate Measurements

The heart rates of the subjects were taken at rest with a Polar RS800 (Made in Finland) device, a radio band connected to the chest level, and a watch worn on the wrist. Immediately after the exercise test (fatigue), a total of 10 measurements were made with the recovery period 1st, 3rd, 6th, 9th, 15th, 30th, 60th, 90 minutes later.

2.3 Data Analysis

SPSS 22.0 package program was used for statistical analysis of the obtained data. Mean values and standard errors of the measured parameters of all subjects were calculated. Paired t-test was used to determine the difference between pre-test and post-test values. Significant difference was $p<0.05$.

3. Results

Table 1: Comparison of pre-test and post-test fatigue index, anaerobic peak power and anaerobic relative peak power levels of subjects.

Variables	Pre	Post	P
Peak power (W)	231,78± 57,76	276,52± 54,78	0,07
Relative Peak power (W/kg)	3,60± 0,69	4,33±0,39	**0,04***
Fatigue index (%)	23,14± 5,77	27,61± 5,47	0,07

The anaerobic power measured with the Wingate test are shown table 1. Obtained data are indicated that peak power and fatigue index were not significantly different for pre and post-test. However, relative peak power was significantly higher in post-test ($p < 0.05$).

Table 2: Comparison of Pre-test and Post-test Heart Rate (HR) levels of subjects.

Variables	Pre	Post	P
HR/min -resting	79,63± 5,42	71,00± 3,57	**0,02***
HR/min -fatigue	182,80± 6,40	178,20±6,67	0,14
HR/min 1st min	126,80±15,05	116,57±9,22	0,07
HR/min 3rd min	108,00± 14,26	99,73± 8,23	0,11
HR/min 6th min	105,20± 11,61	98,20± 7,27	0,05
HR/min 9th min	101,80± 10,28	95,56± 6,23	0,14
HR/min 15th min	98,60± 10,19	92,40± 4,40	0,09
HR/min 30th min	91,00± 5,96	86,73± 3,65	0,34
HR/min 60th min	84,00± 4,38	82,20± 4,35	0,11
HR/min 90th min	78,00± 4,00	75,73± 5,19	0,29

Significant difference p < 0.05. Data provided as the mean and standard deviation.
HR was measured with polar before, immediately after in fatigue, 1st, 3rd, 6th, 9th, 15th , 30th , 60th and 90th minutes (shown table 2) . HR levels were same for the all times but except resting time favor of post test ($p <0,05$).

Table 3: Comparison of Pre-test and Post-test lactate levels of subjects.

Variables	Pre	Post	P
Lactate-resting (mmol·L^{-1})	1,61±0,30	1,23± 1,23	0,07
Lactate-fatigue (mmol·L^{-1})	11,75±1,52	9,80±1,91	0,11
Lactate 1st min (mmol·L^{-1})	13,15±1,17	12,00±2,21	0,29
Lactate 3rd min (mmol·L^{-1})	13,48±1,69	12,37±2,03	0,46
Lactate 6th min (mmol·L^{-1})	12,37±2,03	11,88±1,72	0,46
Lactate 9th min (mmol·L^{-1})	11,44±1,47	10,81±2,10	0,46
Lactate 15th min (mmol·L^{-1})	10,08±1,95	8,92±1,89	0,34
Lactate 30th min (mmol·L^{-1})	6,73±1,69	6,12±1,37	0,29
Lactate 60th min (mmol·L^{-1})	3,25±0,96	2,66±0,34	0,34
Lactate 90th min (mmol·L^{-1})	1,91±0,44	1,97±0,29	0,75

Significant difference $p < 0.05$. Data provided as the mean and standard deviation.

The capillary blood lactate levels were measured right after the lactate level recording. When the all data were analyzed, no significant differences were found between pre and post tests (shown table 3). However, lactate levels were not significantly different, post test values are tend to be lower than pre test.

4. Discussion

In Boxing has a complex structure due to its highly dynamic and static properties and is among the combat sports that require high levels of strength (Mitchell et al., 1994). In this study, the effects of the 6-week competition period boxing training program on peak anaerobic power, fatigue levels and recovery processes were examined in active female boxers.

In the research; The mean age of the subjects was 21.16±0.75 years, and the mean height was 173.50±3.27 cm. Body weight mean pretest 65.28±8.95 kg and posttest 65.50±8.82 kg, there is no statistically significant difference between pretest and posttest.

In the study, when the lactate levels of the subjects were examined, it was seen that 6-week competition training caused a decrease in lactate levels in all timings in a one-to-one comparison in terms of measurement timings, but this decrease was not statistically significant. After the wingate anaerobic strength test, all subjects were given passive rest. Therefore, the lactate level returned to the resting level again in the 90th minute period. The measurement timing with the highest lactate level was found to be 13.48±1.69 after 3 minutes in the pretest, and 12.37±2.03 after 3 minutes in the posttest. The fact that the levels after the 3rd minute are higher than the levels immediately after the exercise is thought to be due to the fact that it takes a certain time for the lactate accumulated in the muscles to pass into the blood. Hanon et al., (2015) reported that there was a significant increase in blood lactate levels of $p<0.05$ before and after a 3x3 boxing match among 28 male elite boxers from the European continent and evaluated each weight separately. they reported that all weights had blood lactate values in the range of 11-17 mmol/L-1 after a boxing match. In addition, they reported that the lowest lactate level was 11.4 mmol/L-1 in the 48 kg weight group, and the highest value was in the 64 kg weight group with 17.0 mmol.L-1 value.

In the research, when the pretest and posttest, HR (heart rate) levels of the 6-week competition training of the subjects were examined, similar to the lactate levels, when all timings were compared, there was a decrease in the posttest HR levels, but this decrease was not statistically significant, only the decrease in HR at the resting level was significant ($p< 0.05$). The highest HR level before the Wingate anaerobic strength test was found to be 182.80±6.40 in the posttest fatigue timing, and the highest posttest value was 178.20±6.67 in the same timing (posttest fatigue). Due to the passive resting period after the test, resting conditions were returned at the 90th minute period. It can be said that the significant ($p<0.05$) decrease in HR, the resting level and the significant decrease in other timings, although not significant, can be said that the 6-week competition period boxing training provides a performance improvement, albeit partially, in boxers. Ghosh (2010) gave 6 male boxers a one-minute rest between rounds and reported the HR level as 178 ±6 after 3x3 sparing, 192±6 after 2x4 punching bag training, and 190±7 after 2x6 sparing. Bürger-Mendonça et al, (2015) examined the lactate levels during 3X2 competition made by 8 male taekwondo players, 1.05±0.35 at rest, 5.18±0.90 after 1st round, 7.05±2.17 after 2nd round, 3. They reported it as 7.36±2.97 after the round, 6.26±2.79 after 3 minutes, 5.58±2.57 after 5 minutes, 4.48±2.20 after 10 minutes. In addition, they report that taekwondo players need a high glycolytic anaerobic system, since blood lactate level increases more significantly with each round during the taekwondo competition.

It is seen that the HR levels are significantly lower, although not statistically, numerically. This is also seen in the paired comparison, and the increase in the next parameters, peak anaerobic power and relative anaerobic power, supports this. Chatterjee, Banerjee, and Majumdar (2006) 20 female boxers aged 17-24 were given 3x2, 1 minute rest sparing training during and after the camp period, mean HR at the end of the first round 171±11, at the end of the second round mean HR 181±8, at the end of the third round. mean HR was 184±7 and mean HR in 3 rounds was 179±8. In addition, Chatterjee et al., (2006) reported the 1st round maximal HR level of female boxers as 183±6, 2nd round maximal HR level as 189±6, and 3rd round maximal HR level as 193±7 in the same study. In our study, we found the highest (maximal) HR level in women after the pretest arm wingate anaerobic strength test, 182.80±6.40. As a matter of fact, it is seen that the average HR level in a match in female boxers is 180-190 HR/min. Therefore, training plans and tests to be made suggest that this reference range should be taken into account. El-Ashker and Nasr (2012) applied a boxing training program with an average of 80% intensity for an 8-week competition to 17 Egyptian male boxers aged 18-23 years. Heart rate was measured after a 15-second exhaustion test applied before the 8-week training period (berofe test 73.1±2.7 beat, at fatigue 197±5.8 beat, after 1min 171±7.2 beat, after 2 min 146 .5±6.9 and after 3 min 139±7.1 beat) after 8 week (berofe test 67,3±1,9 beat, horse fatigue 204±7,2 beat, after 1min 171±7,2 beat, after 2 min 146,5±6,9 beat and after 3 min 139±7.1 beat). In the same study, they reported blood lactate level as 8.7±1.1 after 3X3 roundsparing training performed 8 weeks ago and as 7.3±1.0 after 3X3 roundsparing training performed after 8 weeks training program. . El-Ashker and Nasr (2012) measured the maxVO2± levels of the same subjects to determine the efficiency of 8-week training and the maxVO2 58.2±6.9 ml/kg/min before the 8-week boxing training program and 64.6±7.2 ml/kg/min after. It has been reported that the training program applied by determining the training program as a result of the study increases the O2 usage capacity of the boxers, along with the improvement of the recovery and fatigue levels, and accordingly, the performance increase in the boxers. Smith (2006) found that the lactate levels of boxers aged 18-34 in the England national team after 3x3 rounds were 12.8 mmol/l, 8.6 mmol/l after 5x2 rounds and 13.5 mmol/l after 4x2 rounds. reported.

In the research; when the effects of the 6-week competition period boxing training program of the subjects on the fatigue index, maximal anaerobic power and maximal relative anaerobic power levels were examined; It was determined that the fatigue index and maximal anaerobic power levels were statistically similar between the pretest and posttest, and the increase in the maximal relative power level was significant ($p<0.05$). Gacesa et al., (2009) found the wingate peak anaerobic power of elite Serbian male boxers to be 715.1±90.3 watts, and the relative peak anaerobic power to be 5.8±1.1 W/kg. Hubner et al (2006) found the wingate peak anaerobic power of Caucasian male boxers to be 445.0±80.0 w, and their peak relative anaerobic power to be 5.8±1.1 w/kg. In addition, in the same study, the relative peak anaerobic power of Polish male boxers was found to be 8.0±0.9 w/kg.

5. Conclusion

In conclusion; The significant increase in lactate and HR levels, especially in peak anaerobic power, a significant increase in relative anaerobic power ($p<0.05$), together with the improvement in both rest and fatigue and recovery process, 6-week competition period boxing training contributes to the anaerobic threshold, which improves lactate tolerance in boxers. It is supported the view that more power output is obtained with less fatigue.

Note

This study was produced from the master thesis titled "Effect of WomanBoxers in the CompetitionPeriod of Training on Lactate, Heart Rate andFatigue Index" published in 2017.

6. References

1. Bürger-Mendonça, M., De Oliveira, J. C., Cardoso, J. R., Bielavsky, M., & Azevedo, P. (2015). Changes in blood lactate concentrations during taekwondo combat simulation. Journal of Exercise Rehabilitation, 11(5), 255.
2. Chaabène, H., Tabben, M., Mkaouer, B., Franchini, E., Negra, Y., Hammami, M., . . . Hachana, Y. (2015). Amateur boxing: physical and physiological attributes. Sports Medicine, 45, 337-352.
3. Chatterjee, P., Banerjee, A., & Majumdar, P. (2006). Energy expenditure in women boxing. Kathmandu University Medical Journal (KUMJ), 4(3), 319-323.
4. Çakmakçı, E., Tatlıcı, A., Kahraman, S., Yılmaz, S., Ünsal, B., & Özkaymakoğlu, C. (2019). Does once-a-week boxing training improve strength and reaction time? International Journal of Sport Exercise and Training Sciences-IJSETS, 5(2), 88-92.
5. El-Ashker, S., & Nasr, M. (2012). Effect of boxing exercises on physiological and biochemical responses of Egyptian elite boxers. Journal of Physical Education and Sport, 12(1), 111.
6. Gacesa, J. Z. P., Barak, O. F., & Grujic, N. G. (2009). Maximal anaerobic power test in athletes of different sport disciplines. The Journal of Strength & Conditioning Research, 23(3), 751-755.
7. Ghosh, A. K. (2010). Heart rate, oxygen consumption and blood lactate responses during specific training in amateur boxing. International Journal of Applied Sports Sciences, 22(1), 1-12.
8. Hanon, C., Savarino, J., & Thomas, C. (2015). Blood lactate and acid-base balance of world-class amateur boxers after three 3-minute rounds in international competition. The Journal of Strength & Conditioning Research, 29(4), 942-946.
9. Kravitz, L., Greene, L., Burkett, Z., & Wongsathikun, J. (2003). Cardiovascular response to punching tempo. The Journal of Strength & Conditioning Research, 17(1), 104-108.
10. Mitchell, J. H., Haskell, W. L., & Raven, P. B. (1994). Classification of sports. Journal of the American College of Cardiology, 24(4), 864-866.
11. Özkan, A., Köklü, Y., & Ersöz, G. (2010). Anaerobik performans ve ölçüm yöntemleri. Ankara: Gazi Kitapevi, 119, 127.
12. Pierce Jr, J. D., Reinbold, K. A., Lyngard, B. C., Goldman, R. J., & Pastore, C. M. (2006). Direct measurement of punch force during six professional boxing matches. Journal of quantitative analysis in sports, 2(2).
13. Piorkowski, B. A., Lees, A., & Barton, G. J. (2011). Single maximal versus combination punch kinematics. Sports Biomechanics, 10(01), 1-11.
14. Quinn, A. (1994). Knockout Training Tips. USA, United States Profession Tenis Registry.
15. Savaş, S., & UĞRAŞ, A. (2004). Sekiz haftalık sezon öncesi antrenman programının üniversiteli erkek boks, taekwondo ve karate sporcularının fiziksel ve fizyolojik özellikleri üzerine olan etkileri. Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, 24(3).
16. Slimani, M., Chaabène, H., Davis, P., Franchini, E., Cheour, F., & Chamari, K. (2017). Performance aspects and physiological responses in male amateur boxing competitions: A brief review. Journal of Strength and Conditioning Research, 31(4), 1132-1141.
17. Soslu, R., Güler, M., Ömer, Ö., Devrilmez, M., Cincioğlu, G., Doğan, A. A., & Esen, H. T. (2018). Boksörlerde akut yorgunluğun statik dengeye etkisi. Sportive, 1(1), 19-30.

18. Taşkuyu, E. (2020). Besinsel Nitrat Takviyesinin Anaerobik Performans Üzerine Etkileri. Gaziantep Üniversitesi Spor Bilimleri Dergisi, 5(4), 428-442.
19. Taşkuyu E. ve Yılmaz M. (2021). Besinsel Takviyeler ve Ergojenik Yardımcılar. Dalkılıç M. ve Özer Ö (Ed)., INSAC Sport Sciences (1. baskı) içinde (13-26). İzmir: Duvar yayınları.
20. Tatlici, A., & Cakmakci, O. (2019). The effects of acute dietary nitrate supplementation on anaerobic power of elite boxers. Med. Dello Sport, 72, 225-233.
21. Tatlıcı, A., & Löklüoğlu, B. (2022). Comparison of hamstring quadriceps strength ratios in different combat sports branches. Physical Education of Students, 26(1), 35-40.
22. Tatlici, A., Unlu, G., Cakmakci, E., & Cakmakci, O. (2021). Investigation of the relationship between strength and dynamic balance performance in elite wrestlers. Ido Movement for Culture. Journal of Martial Arts Anthropology, 21(3), 18-22.
23. Zorba, E., Ziyagil, M., & Erdemli, İ. (1999). Türk ve Rus Boks Milli Takımlarının Bazı Fizyolojik Kapasite ve Antropometrik Yapılarının Karşılaştırılması. Gazi Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi, 1, 17.